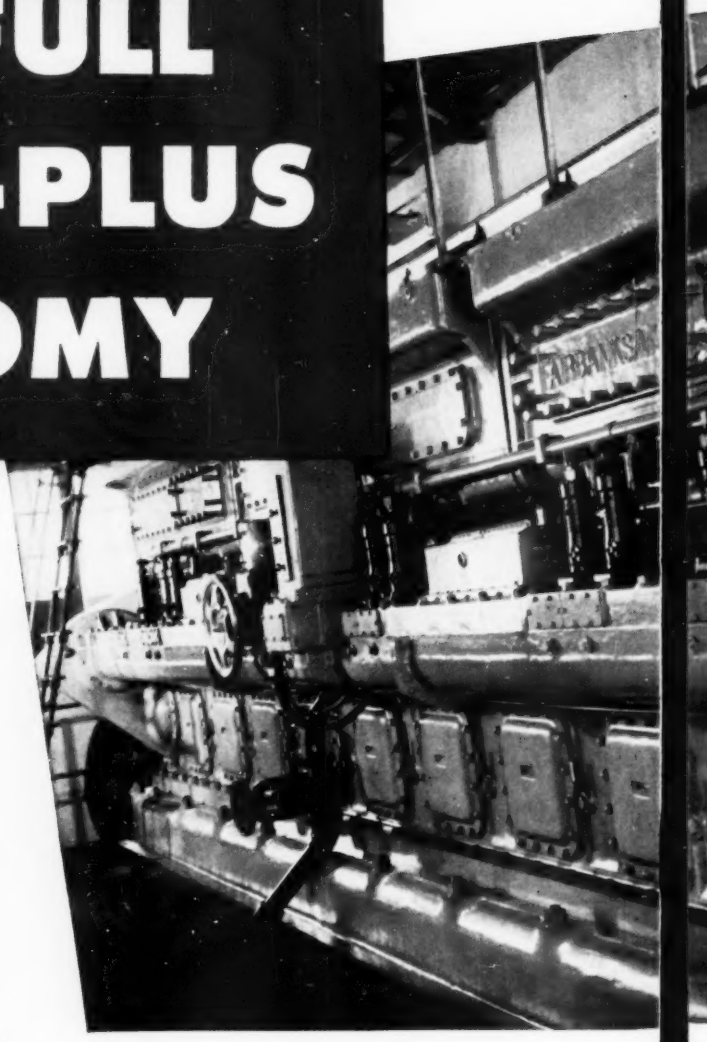
DIESEL POWER

AND DIESEL TRANSPORTATION

SEPTEMBER, 1952

- ***Heavy Shop Conversion—Steam to Diesel***
- ***Light Weight Packard Diesel***

GETS FULL POWER-PLUS ECONOMY



...with the help of TEXACO URSA OILS

As in the plant illustrated, operators of Diesel, gas, and dual-fuel engines everywhere are getting full power and low maintenance costs with the help of *Texaco Ursa Oils*. These oils reduce fuel consumption because they keep rings free, ports open, and valves functioning properly — assuring better compression and combustion.

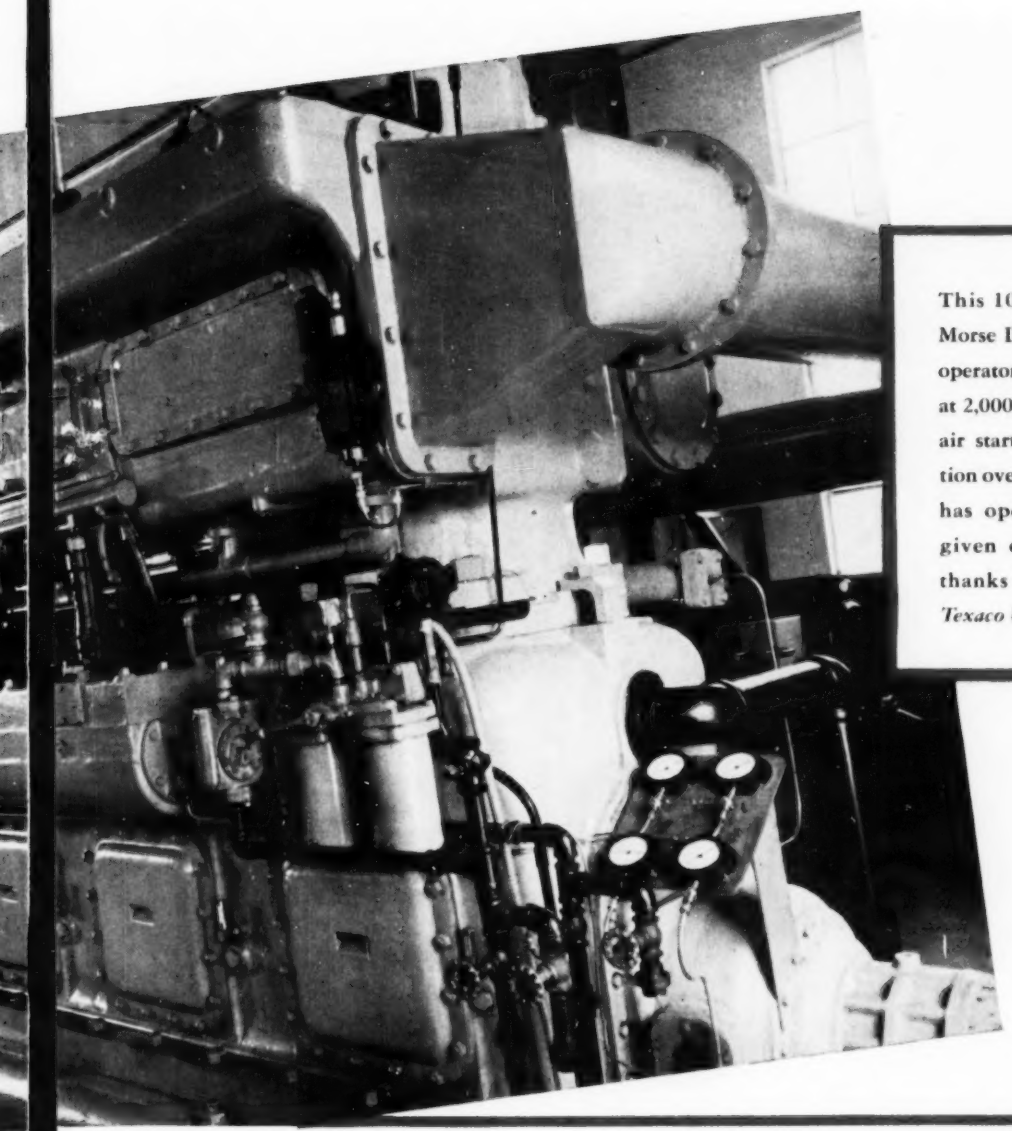
Texaco Ursa Oils are world-famous for their ability to resist oxidation and sludging, to stand up under heat and pressure, and keep engines clean for trouble-free performance. You get longer service life from bearings and all moving parts . . . increased efficiency and reduced maintenance costs.

Texaco Ursa Oils are available in every needed

TEXACO

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for Sept. 1952, Vol. XXX, No. 9. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial at 192 Lexington Ave., New York 16, N. Y. Subscription rate: United States, $3.00 per year, single copies 35¢; Canada $4.00; Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut under Act of March 3, 1879.



This 10-cylinder Fairbanks-Morse Diesel engine (name of operator on request) is rated at 2,000 h.p. at 300 rpm, and is air starting. Since its installation over a year ago, this Diesel has operated smoothly and given economical power — thanks to lubricating with *Texaco Ursa Oils exclusively.*

viscosity. Approved by leading engine manufacturers and recommended by users from coast to coast, they are easily America's favorite. In the Diesel field alone:

For over 15 years, more stationary Diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.

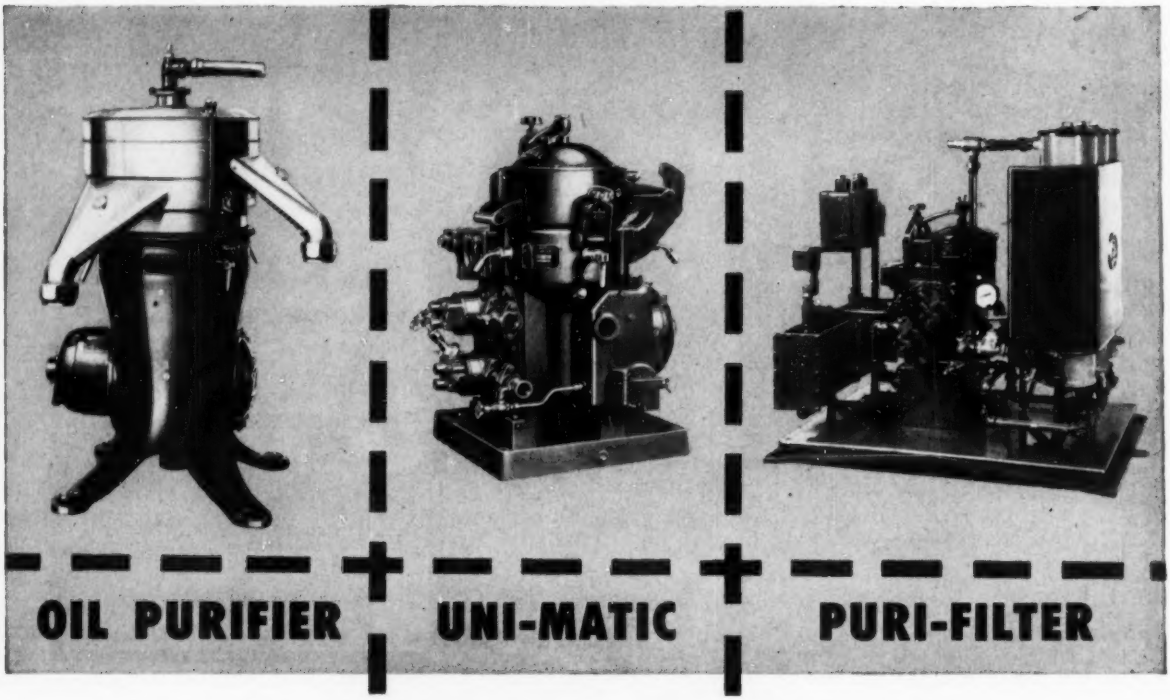
A Texaco Lubrication Engineer will gladly show you how *Texaco Ursa Oils* will reduce costs in your operation. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

Faithfully yours 50 *for Fifty Years*



WHICH ONE?

De Laval Oil Purifiers are supplied in types and sizes for every plant need. ***All*** types . . . straight Oil Purifier . . . "Uni-Matic" Oil Purifier . . . or "Puri-Filter" . . . perform the same basic function equally well — they all throw out of the oil by means of centrifugal force, all solid and liquid impurities. But each machine has its place.

The straight Oil Purifier is used where it is desirable to install separate pumps to carry the oil to and from the purifier. This type of De Laval machine comes in the widest range of capacities, from 5 gph to 1800 gph dependent on the viscosity of the oil being purified.

The "Uni-Matic" is built with its own pumps. When necessary, a heater is also supplied. It is ready to operate as soon as it is piped up to the oil supply.

The "Puri-Filter" is a complete De Laval "Uni-Matic" plus a set of three or more filters. The filters remove colloidal carbon and other minute contaminants that get into diesel oil, or remove fly ash from turbine oil. Because it combines centrifugal force and micronic filtration, it leaves oil visibly clean—practically transparent. Its capacity depends on that of its basic unit —the De Laval "Uni-Matic" Oil Purifier.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS

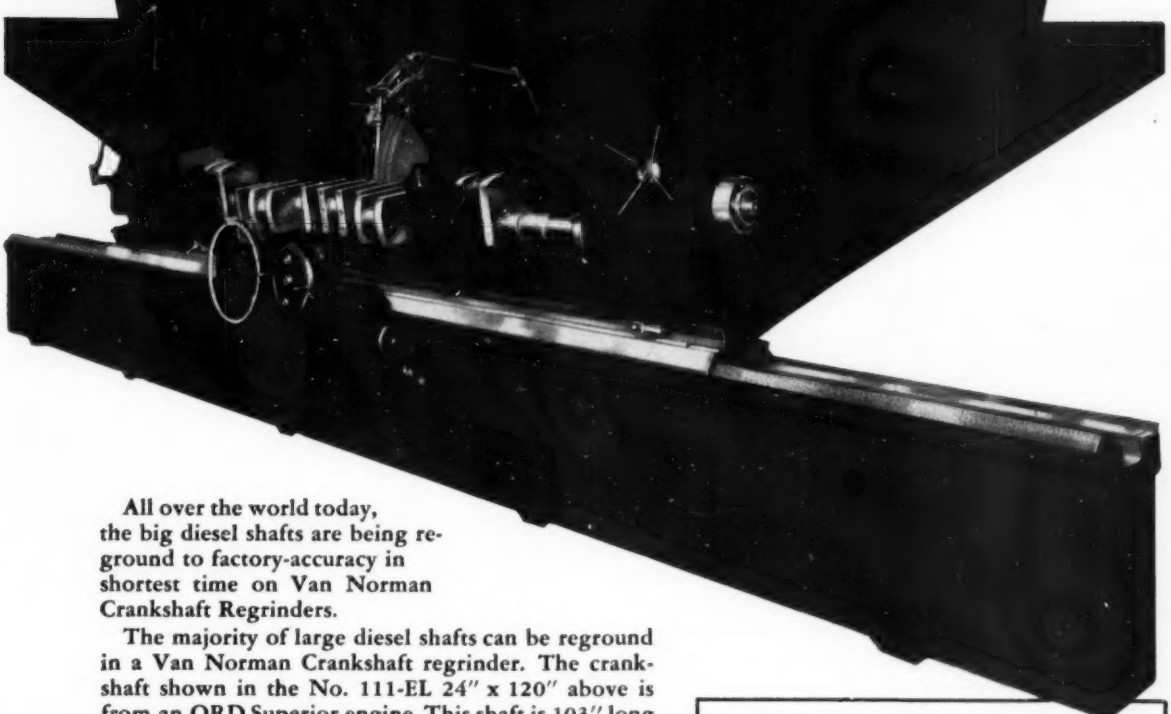
FOR MORE DEPENDABLE POWER PRODUCTION

Make More Money!

Grind Your Own Shafts with this

VAN NORMAN

No. 111-EL-34



All over the world today, the big diesel shafts are being reground to factory-accuracy in shortest time on Van Norman Crankshaft Regrinders.

The majority of large diesel shafts can be reground in a Van Norman Crankshaft regrinder. The crankshaft shown in the No. 111-EL 24" x 120" above is from an ORD Superior engine. This shaft is 103" long and has a 10½" stroke.

The heavy-duty, well-ribbed, hand-scraped, cast iron base plus the many other high quality precision machine tool features assure accuracy throughout many years.

Get in on the big money to be saved in grinding these big shafts. WRITE FOR FULL DETAILS AND PRICES TODAY! Van Norman Co., Springfield 7, Mass.

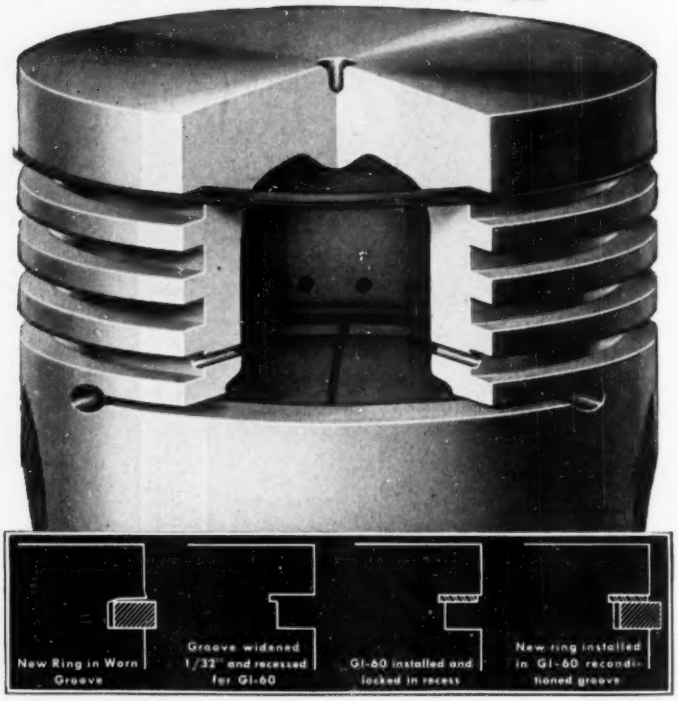
VAN NORMAN BUILDS 3 EXTRA-LARGE REGRINDERS:

No. 111, for shafts 84" long, 24" swing
No. 111-EL-24x120", for shafts 120" long, 26" swing
No. 111-EL-34x130", for shafts 130" long, 34" swing

The Best-Equipped Shop Gets the Business! ... that's why *"It Pays to Van Normanize"*

Sealed Power Pioneered

the only dependable, economical answer to top-ring groove wear


New Ring in Worn Groove
Groove widened 1/32" and recessed for GI-60
GI-60 installed and locked in recess
New ring installed in GI-60 reconditioned groove

Sealed Power GI-60 Groove Insert

STILL ALONE IN ITS FIELD

Top-ring groove wear is a problem as old as piston rings. Top-ring grooves have always had the least lubrication, the most heat, the heaviest wear. Many remedies were tried. Regrooving and installing wider rings violated the intent of the engine designer. A loose, floating spacer amounted to the same thing as using a wider ring in two sections.

Sealed Power engineers wrestled with the problem for years, and came up with the only satisfactory answer to date. It is a heat-treated, spring-steel insert, securely anchored to the top of the ring groove, which has been regrooved to an absolutely true surface 1/32" wider than before. A recess 1/32" wide is cut at the top, and the insert locks itself permanently into this recess, held by its own inward tension, and dished to hug the top of the groove. It is called the Sealed Power GI-60 Groove Insert.

Many fleet owners are now using Sealed Power GI-60 on new replacement pistons, as well as re-conditioned pistons. One reports that since adopting the standard practice of installing GI-60, average piston life has been more than tripled.

Sealed Power GI-60 Groove Insert is only one of many improvements originated by Sealed Power Corporation, leader in the piston ring field since 1911.

SEALED POWER CORPORATION, MUSKEGON, MICHIGAN

Sealed Power Piston Rings

PISTONS • CYLINDER SLEEVES

You Can Clean This Fluid Strainer Without Stopping the Flow

Cuno AUTO-KLEAN is the *only* fluid strainer with "comb-action cleaning" which permits it to work uninterruptedly. Dirt accumulations are dislodged *while* the straining goes on. This can be done automatically. *Guaranteed* to remove 100% of all solids larger than specified.

CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

No Risks With Discs

The all-metal disc element in Cuno AUTO-KLEAN positively cleans lube and fuel oil of all solids larger than specified.*

This compact strainer handles full flow in minimum space. When the strainer itself needs cleaning, you don't have to stop the engine.

When the disc element is rotated—manually or automatically—cleaner blades "comb out" all accumulations between the discs, no matter how sticky or deeply embedded.

The Indestructible Strainer

This "comb-action" type of cleaning is much more thorough than mere surface-scraping. It restores full initial capacity and free area. And there's no danger of pushing dirt through the strainer into the discharge flow.

The discs are permanent, non-collapsible, unbreakable. No chance of an unsuspected gap or channel to occur, permitting passage of harmful solids. And—nothing to wear out and need replacing.

Cuno AUTO-KLEAN Strainers are available for built-in or external installation. Continuously cleanable feature permits single unit installation. Straight-line connections for simplicity of installation on either fuel or lube.

**Models available for straining from .0055 to .062 in.*

Cuno Engineering Corporation
Dept. 255A, South Vine Street, Meriden, Conn.

Please send information on Cuno AUTO-KLEAN Strainer for Diesel protection.

Name.....

Company.....

Address.....

City.....Zone....State.....

Please attach to business letterhead

"Tycol Acylkup keeps bearings running cool... does not emulsify with water"

That's right! Tycol Acylkup Grease withstands heavy unit pressures . . . resists emulsification with water. It is easily applied by grease gun or central system.

Further, Tycol Acylkup Grease contains a high grade paraffin base cylinder oil that steps up bearing efficiency and assures increased bearing life. Protection against wear is long-lasting.

Your nearest Tide Water Associated Office will be glad to give you complete information. Call or wire today.

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SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"

Buehler ANNOUNCES

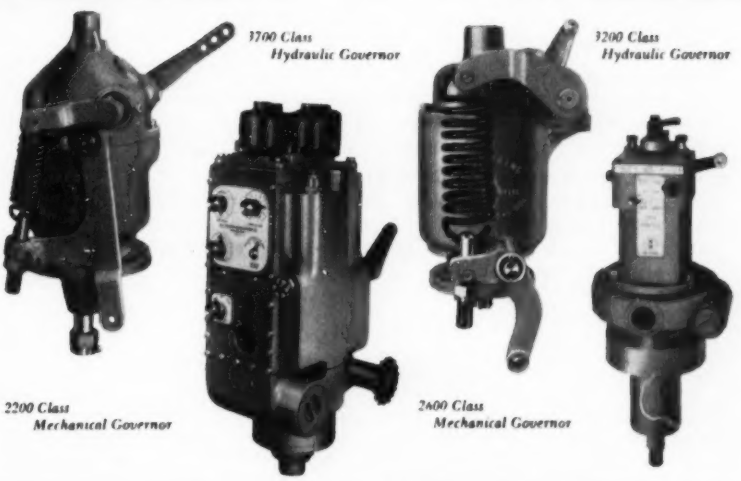
the purchase of

THE PICKERING GOVERNOR CO.

Buehler, Inc., manufacturers of automatic machinery and precision instruments for many years, has acquired all of the assets of The Pickering Governor Co., and is now actively producing the full line of Pickering hydraulic and mechanical types of governors.

The production and further development of engine speed governors constitutes the principal activity of the new owners. The Company is now ready to render prompt and efficient service.

A competent engineering staff is available. For consultation on your governor problems, write The Pickering Governor Co., Paramus, New Jersey.



THE PICKERING GOVERNOR CO.
ESTABLISHED 1944
ROUTE 17 — SOUTH OF ROUTE 4
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Phone HUbbard 7-1600

Why the leaders prefer

PUROLATOR

FULL-FLOW

MICRONIC FILTERS

✓ **Full-flow rates within practical filter dimensions:** The famous "accordion-pleated" Micronic* filter element has up to ten times more filtering area than old-style filters—gives high flow rates in a minimum of space.

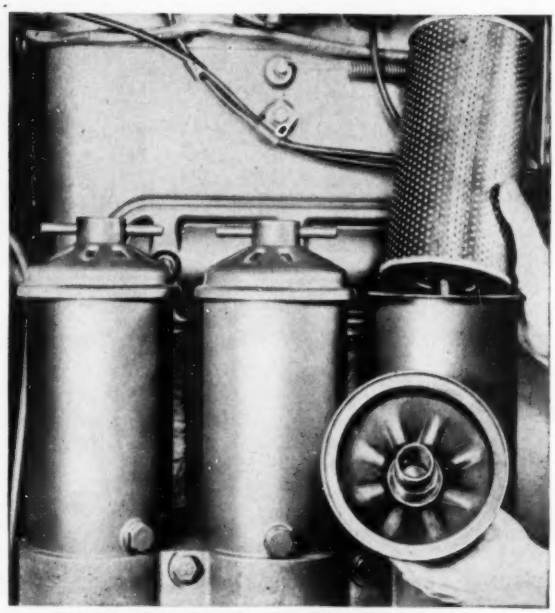
✓ **Ultra-micronic filtration:** High flow rates are, of course, meaningless unless effective filtration is maintained, too. Electron micrographs prove that the Purolator* Micronic filter stops particles down to *submicrons*—.0000039 in.!

✓ **Maximum dirt storage capacity:** The pleated design of the Micronic filter element provides many times more dirt storage space than old-style filters. This important advantage means uniform, efficient performance and a lengthy service life.

✓ **Minimum pressure drop:** The Purolator Micronic filter element introduces a remarkably small pressure drop in the lubricating system . . . permitting pumps of practical size and simple type.

✓ **Will not remove or absorb additives:** With Purolator Micronic filtration, you keep *all* the oil quality you pay for. The Micronic filter element will not strip additives . . . an important advantage with modern HD and heat-resistant oils.

*Reg. U. S. Pat. Off.



Purolator Micronic Filters in a typical Diesel full-flow installation. Although the Purolator Micronic filter elements measure only 4½ in. by 9 in., each one filters 9 gallons of oil per minute, giving a total of 27 g.p.m. for the complete filter unit.

THE advantages of Purolator Full-Flow Micronic filtration—wherein *all* the oil is filtered *each time* it passes through the engine—have been dramatically demonstrated during the past few years. In some instances engine life has been increased by thousands of hours, bearing and ring wear has been reduced to almost imperceptible minimums, and engines have been made to operate efficiently where air-borne abrasives formerly destroyed them in a matter of hours. One after the other, leading makers of Diesel and gasoline engines and vehicles are adopting full-flow lubrication . . . and standardizing on Purolator Full-Flow Micronic filters. In some fields, manufacturers are finding that full-flow lubrication is becoming a necessary feature to maintain a competitive sales position.

Time and again, in impartial tests conducted by vehicle and engine manufacturers themselves, Purolator Micronic filters have been proved best on all counts . . . fineness of filtration, long service life, ease of servicing.

Our Engineering Department will gladly co-operate in helping you prove—*in your own way, on your own equipment*—that there is no finer filter made than Purolator. Simply write, describing your equipment and filter requirements.

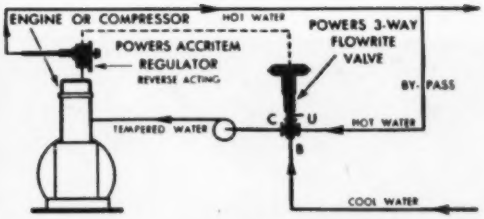
PUROLATOR PRODUCTS, INC.
Rahway, New Jersey, and Toronto, Ontario, Canada
Factory Branch Offices: Chicago, Detroit, Los Angeles

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"

Before You Buy

JACKET WATER TEMPERATURE CONTROL

Investigate



One of Many Applications of
POWERS ACCRITEM REGULATOR and FLOWRITE DIAPHRAGM VALVE—
Compressed Air or Water Operated

—Provides positive, dependable control for large size 3-way or 2-way valves. ***Safety feature*** of hook-up above: failure of air or water pressure allows only cooling water to flow through the valve to engine.

POWERS

Complete Line of Dependable, Time-Tested Regulators

IMPORTANT ADVANTAGES that quickly pay back the cost of Powers self-operating and pneumatic controls for air compressors, diesel and gas engines:

- **Correct jacket water and lube oil temperature at all times, regardless of load or seasonal changes.**
- **Improved lubrication and cylinder liner wear.**
- **Fewer piston ring replacements.**
- **Saves Labor; increases efficiency.**
- **Reduces danger of piston seizure.**
- **Eliminates sludging.**
- **Lowers fuel and lube oil consumption.**

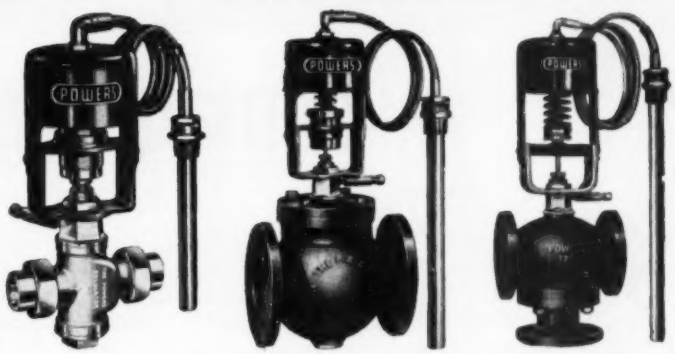
Cost of Powers jacket water temperature control? About the same as a set of new piston rings. Powers regulators are unsurpassed for reliability and years of trouble free service.

Have a POWERS Engineer call to study your requirements for better jacket water temperature control. There's no obligation. Phone or write our nearest office.

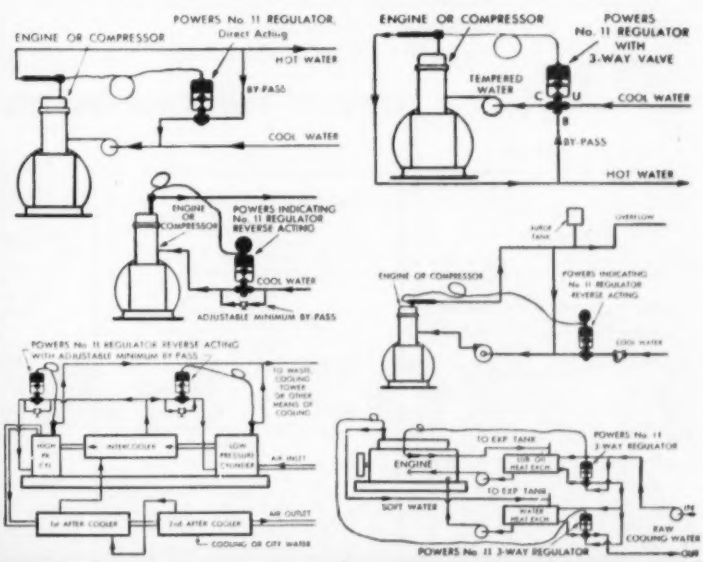
CHICAGO 13, ILLINOIS • 3819 N. Ashland Ave.
NEW YORK 17, NEW YORK • 231 East 46th Street
LOS ANGELES 5, CALIF. • 1808 West 8th Street
TORONTO, ONTARIO • 195 Spadina Avenue
Factory and General Office • Skokie, Illinois

(DIG)

No. 11 Self-Operating TEMPERATURE REGULATORS

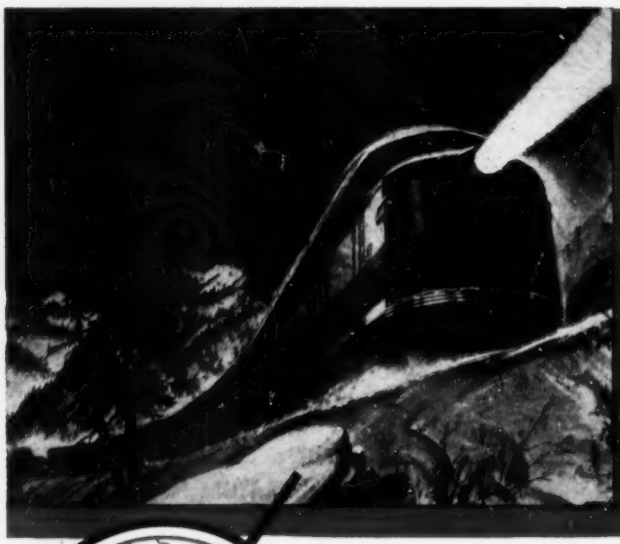


Provide dependable control for most applications. They're simple, ruggedly built, economical and easy to install. Especially suited for air compressors, diesel and gas engines. Temperature indicating regulator also available.



Established 1891 **THE POWERS REGULATOR CO.** OFFICES IN OVER 50 CITIES

tough jobs –



demand AMERICAN BOSCH

All over the world, more and more Diesel engines with American Bosch fuel injection equipment are delivering efficient, dependable, economical performance—in trucks and tractors, in locomotives, workboats and stationary power installations.

And world-wide American Bosch service keeps pace. In North America alone, 126 authorized American Bosch stations now serve Diesel users, with new facilities being constantly added to meet new needs.

At these stations, factory-trained mechanics apply the latest and most efficient service methods... work with test equipment and specialized service tools that are designed and built to high factory standards for prompt, accurate, reliable servicing.

Complete precision service like this saves time and money for owners of American Bosch-equipped Diesels ... helps keep their engines working at top efficiency. It's another reason why dependable fuel injection equipment by American Bosch *stays dependable*—everywhere—throughout a long and economical life. American Bosch Corporation, Springfield 7, Massachusetts.

SERVICE STATIONS IN THE UNITED STATES

ALABAMA

Birmingham 3, Birmingham Electric Battery Co., Ave. B & 23rd St. S.

ARIZONA

Mesa, Perkins Diesel Service, 747 South Mesa Blvd.
Phoenix, Charlie C. Jones Battery & Electric Co., 318-322 W. Jefferson St.
Tucson, Auto-plane Electrical Service, 1037 South 6th Ave.
Yuma, Yuma Automotive Electric Co., 229 Eighth Street

ARKANSAS

N. Little Rock, Womack Bros. & Taylor, 522 E. Washington.

CALIFORNIA

Calexico, Calexico Pump & Magneto Co., 115 East Third St.
Eureka, Industrial Diesel & Electric, 5th & Commercial Sts.
Fresno, Winther Bros., 612 Divisadero St.
Los Angeles, Diesel Injection Equipment Co., 4847 Anaheim Telegraph Rd.
Los Angeles 21, Magneto Sales & Service Co., Inc., 751 Towne Ave.
Los Angeles, The Jarvis Company, 1442 No. Spring St.
Sacramento 6, Langner & Rifkin, 1116-22 15th St.
Salinas, Haag Diesel Electric, 37 Abbott St.
San Diego, Magneto Sales & Service Co., 1254 Kettner Boulevard
San Francisco 3, Furrer & Uster, 225 Seventh St.
Wilmington, Diesel Control Corp., 218 N. Marine Ave.

COLORADO

Denver 3, Central Supply Company, 1171 Lincoln St.

CONNECTICUT

Hartford, W. J. Connell Co. of Hartford, 85 Airport Road

DISTRICT OF COLUMBIA

Washington, Diesel & Ignition Service Inc., 925 Girard St., N.E.

FLORIDA

Jacksonville, Patten Sales Co., Inc., 1021 Hogan St.
Jacksonville 1, Spencer Electric, Inc., 40 W. Beaver St.
Miami 36, Florida Diesel Service Co., 1930 N. Miami Ave.
Tampa, Stuart Diesel Service, 3101 4th Ave.

GEORGIA

Atlanta 3, Auto Electric & Magneto Co., 477 Spring St. N.W.
Cairo, Grady Motors, 201-5th St., N.E.

IDAHO

Boise, Magneto & Diesel Supply Co., 2406 Main St.
Lewiston, Osterman Diesel & Electric Co., 1610 Main St.

ILLINOIS

Chicago 16, Illinois Auto Electric Co., 2011-37 So. Indiana Ave.
Peoria, Automotive Ignition Co., 522 Franklin St.
Rock Island, Lohse Automotive Service, 430 17th St.

INDIANA

Indianapolis 4, Gulling Auto Electric Inc., 450 N. Capitol Ave.

IOWA

Cedar Rapids, Edwards Carburetor & Electric Co., 209 Seventh St. S.E.
Des Moines, Electrical Service & Sales Co., 1313 Walnut St.

KANSAS

Wichita 2, E. S. Cowie Electric Co., 230 S. Topeka Ave.

KENTUCKY

Louisville, Diesel Injection Service, 3206 So. Preston St.
Louisville, Schaaf Auto Electric Co., Broadway at Jackson

LOUISIANA

New Orleans, Gerhardt's Fuel Injection Service, 2501 Jefferson Hwy.
New Orleans 13, John M. Walton, Inc., 1050 Carondelet St.
Shreveport, Vaughan Tractor & Auto Parts Co., 224 Airport Drive

MAINE

Portland 5, Portland Tractor Co., Inc., 803 Forest Ave.

MARYLAND

Baltimore 1, Parks and Hull Automotive Corp., 1033 Cathedral St.
Baltimore, Stephen Seth & Co., 876 Park Ave.

MASSACHUSETTS

Boston 15, W. J. Connell Company, 121 Brookline Ave.
Boston 10, Wharf Machine & Electric Co., Inc., Fish Pier Road
Fairhaven, Hathaway Machinery Co., Inc. Hathaway-Braley Wharf

MICHIGAN

Detroit, Knorr-Maynard, Inc., 5743 N. Woodward Ave.

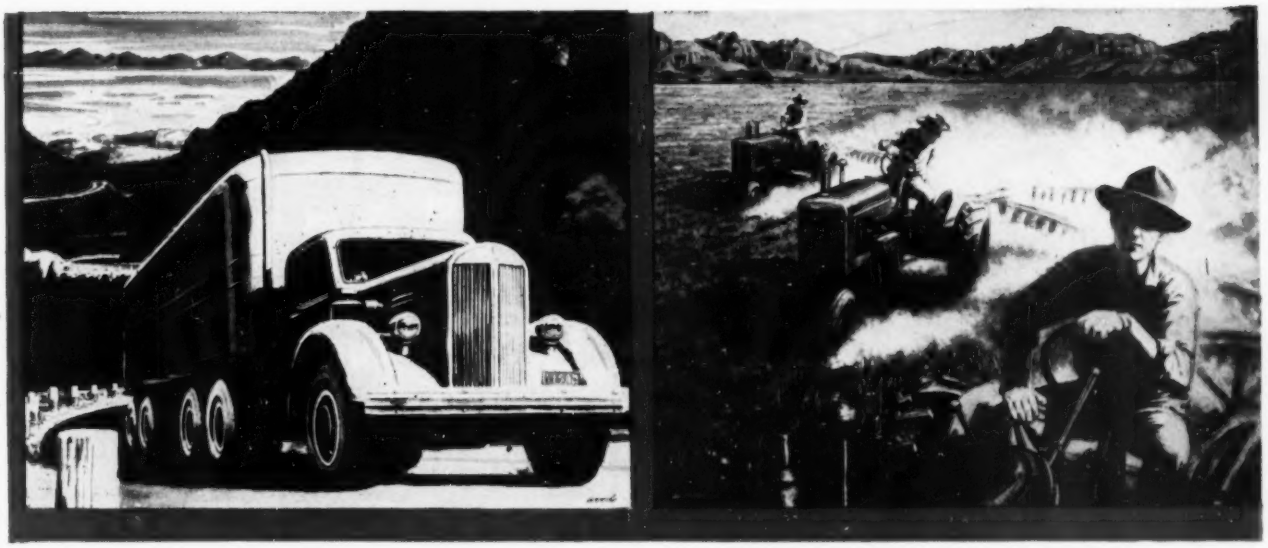
MINNESOTA

Minneapolis, Diesel Service Co., 2509 E. Lake St.
Minneapolis 2, Reinhard Bros. Co., Inc., 11 South 9th St.

MISSISSIPPI

Jackson, Womack Brothers, 1305 South Gallatin St.

-EVERYWHERE--



performance and service

MISSOURI
Kansas City 8, Electrical & Magneto Service Co., 2538 Grand Ave.
St. Louis 23, Diesel Fuel Injection Service Co., 9331 So. Broadway
St. Louis 3, Electric Parts and Service Co., 2900 Washington Blvd.

MONTANA
Billings, Original Equipment, Inc., 423 North Broadway

NEBRASKA
Omaha 2, Carl A. Anderson, Inc., 16th & Jones

NEW JERSEY
Fords, Diesel Engineering & Equipment Co., Inc., 219 New Brunswick Ave.
Newark 2, Tire Trading Company, Inc., 239 Halsey St.

NEW MEXICO
Albuquerque, Hill Auto Electric Service, 415 W. Marquette Ave.

NEW YORK
Brooklyn 9, E. A. Wildermuth, Inc., 1102 Atlantic Ave.
Bolivar, Bolivar Magneto Co., 60 Wellsville St.
Buffalo 8, Hettrich Electric Service, 1032 Ellicott St.
New York 19, American Bosch Corp., New York Service Sales Division, 601 W. 51st St.
Pelham Manor, Coretti-Gross, Inc., 44 Secor Lane
Syracuse 4, F. A. Crossman, Inc., 943 West Genesee St.
Troy, Ehrlich Electric Service, Inc., 200 Fourth St.
Utica, Stiefvater Electric Co., Inc., 320-322 Lafayette St.

NORTH CAROLINA
Charlotte, Carolina Rim & Wheel Co., 301 East 8th St.

NORTH DAKOTA
Fargo, Northwestern Diesel Equipment Service, 2800 Front St.

OHIO
Cincinnati, Tri-State Distributing Corp., Broadway at Eighth
Cleveland 14, The Cleveland Ignition Co., 1301 Superior Ave.
Columbus 15, Columbus Ignition Co., 211 Neilston St.
Lisbon, Diesel Service Co., 234 East Washington St.

OKLAHOMA
Fairview, Keck Bros. Diesel Service, 322 S. Main St.
Oklahoma City 2, American Electric-Ignition Co., 124 N.W. 8th St.
Tulsa, Magneto Ignition Company, 701 West 5th St.

OREGON
Klamath Falls, Diesel & Electric Service, 1950 So. Sixth St.
Pendleton, Eds Magneto & Diesel Co., S.W. 18th & Court St.
Portland 14, Automotive Products, Inc., 1700 Southeast Grand Ave.
Roseburg, Diesel Products Co., 303 E. 2nd Ave. S.

PENNSYLVANIA
Hazleton, Penn Diesel Service Co., 27th & N. Church Sts.
Philadelphia, Sullivan Brothers, 1718 Fairmount Ave.
Pittsburgh 13, Automotive Ignition Co., Inc., 6358-6364 Penn. Ave.

SOUTH CAROLINA
Charleston, Diesel Fuel Injection Service, No. 2 Exchange St.

TENNESSEE
Knoxville, Diesel-Magneto Service Co., 1209 Island Home Ave.
Memphis 4, Automotive Elec. Service Co., 982 Linden Ave.

TEXAS
Amarillo, Radcliff Brothers Electric Co., 214 Buchanan St.
Dallas 1, Beard & Stone Electric Co., Inc., 3909 Live Oak St.
El Paso, Reynolds Battery & Magneto Co., 801 Myrtle Ave.
Houston 1, Beard & Stone Electric Co., Inc., 805 Polk Ave., P. O. Box 1717
Odessa, Electric Service & Supply, P. O. Box 1471
San Antonio, S. X. Callahan, 425 N. Flores St.
San Antonio, Womack Bros., 1018 S. Presa St.

UTAH
Salt Lake City, Diesel Electric Service & Supply Co., 58 East 7th South

VIRGINIA
Norfolk, Diesel Injection Sales and Service, 808 Union St.
Richmond, C. H. Woodward Electric Co., Inc., 709 W. Broad St.

WASHINGTON
Davenport, Wagner Diesel & Electric, P. O. Box 165
Seattle, Seattle Injector Co., 2706 Second Ave.
Seattle, Sunset Electric Co., 300 Westlake North, P. O. Box 3148
Spokane, Sunset Electric Co., North 703 Division St.
Walla Walla, Industrial Products Co., 610 N. Ninth St.

WISCONSIN
Milwaukee 2, Wisconsin Magneto Company, 918 N. Broadway

ALASKA
Anchorage, Automotive Diesel Electric Supply & Overhaul, P. O. Box 1160
Juneau, Parsons Electric Company, Second & Seward Sts., P. O. Box 2201

HAWAIIAN ISLANDS
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Honolulu, Todoki Machine & Marine Works, 810 Halekauwila St.

PUERTO RICO
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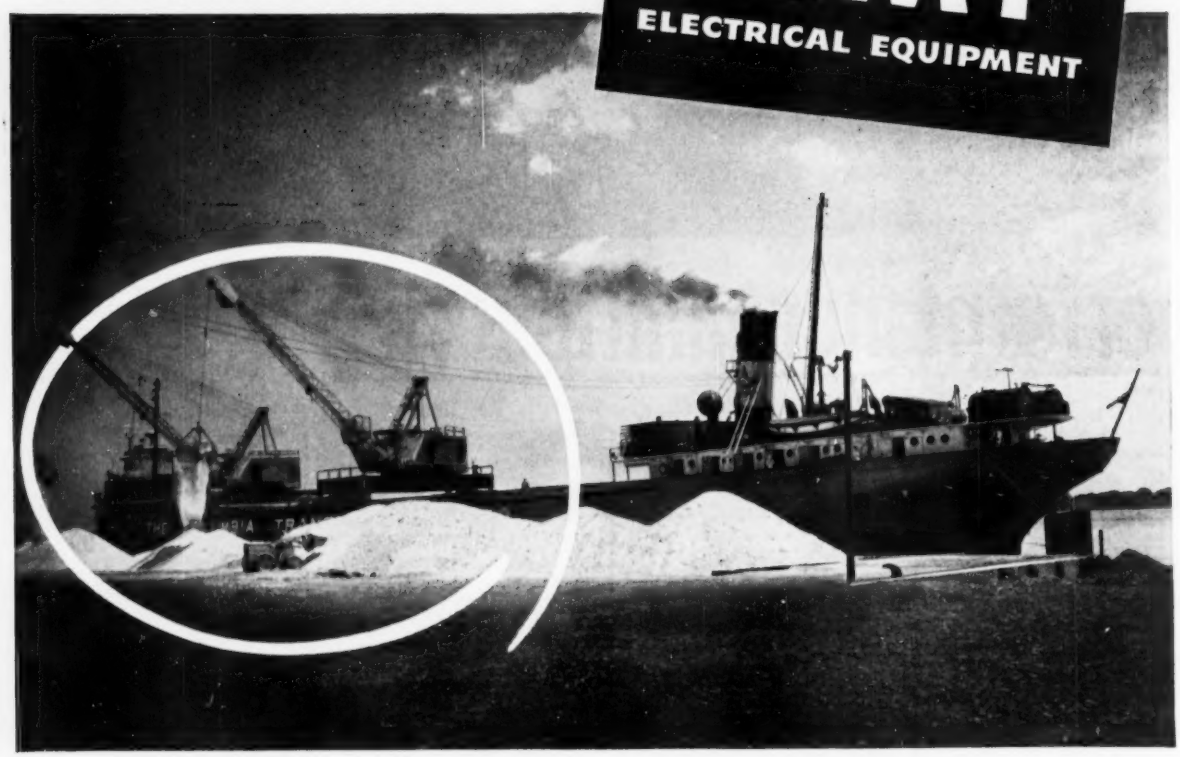
DELCO-REMY
ELECTRICAL EQUIPMENT

The W. C. Richardson, with new Diesel-powered cranes, unloads 4,000 tons of sulphur and is under way again in 11 hours.



Dependable Delco-Remy-equipped Diesel engines power the huge traveling cranes of this Great Lakes cargo carrier . . . bring new efficiency in loading and unloading.

Ashore or afloat, wherever Diesels serve America, you can expect to find reliable Delco-Remy electrical equipment—generators, regulators, cranking motors, switches, batteries—teamed with the Diesels for better operation, lower costs.

DELCO-REMY ELECTRICAL EQUIPMENT
A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE
DISTRIBUTED BY WHOLESALERS EVERYWHERE

Delco-Remy

DIVISION, GENERAL MOTORS CORPORATION
ANDERSON, INDIANA

DELCO-REMY • WHEREVER WHEELS TURN OR PROPELLERS SPIN

Put 'em on a diet . . . with Pure Oil Industrial Lubricants

In the complete line of high-quality industrial lubricants Pure Oil makes, you will find many oils and greases designed to do several *different* jobs, instead of one specific job.

And to do each job *equally well.*

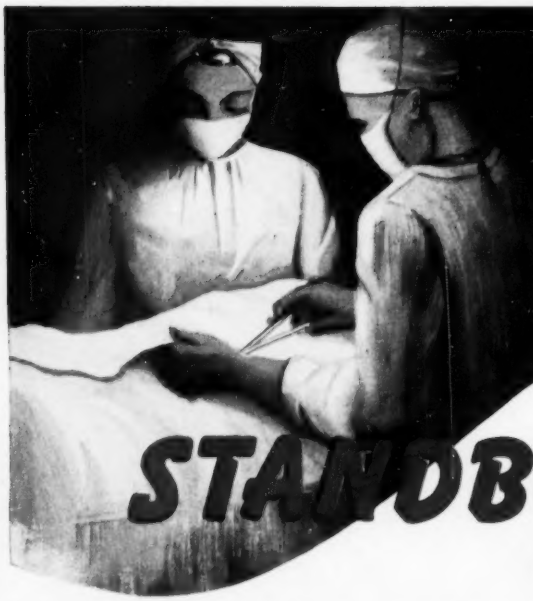
This makes it possible for you to do *all* your lubricating with *fewer* lubricants. In other words, you can

simplify and save . . . with Pure Oil Industrial Lubricants

If you would like to keep your lubrication requirements from hogging your profits (and a penny saved is more than ever a penny earned, these days!) write: The Pure Oil Company, Industrial Sales, 35 E. Wacker Drive, Chicago 1, Illinois.

Be sure with Pure

THE PURE OIL COMPANY, U.S.A. — PURE



WHERE LIGHT MAY MEAN A LIFE

AUTOMATIC STANDBY POWER IS ESSENTIAL

Many lives have been saved due to there being an AUTOMATIC "Stand-By" power plant to instantly take over when the main source of power fails.

SYNCHRO-START PRODUCTS are the originators of these control systems and for the past 20 years have specialized in the design and manufacture of this equipment only. In that time, we have shipped many thousands of these controls to all parts of the world for almost every conceivable power application.

The automatic control equipment required to insure that emergency power will take over in a matter of seconds, demands dependable controls designed and manufactured by a company that has the "know-how".

When you order your power plant, be sure to specify SYNCHRO-START Automatic Controls. They have proven their DEPENDABILITY.

Ask your engine manufacturer — dealer — architect — engineering firm or write us for further information and our nearest representative.

SYNCHRO-START PRODUCTS, INC.

Automatic Engine Control Equipment

8151 NORTH RIDGEWAY AVENUE, SKOKIE, ILLINOIS

EXIDE STARTING POWER

Packed with plenty of "giddap and go"

You get action . . . prompt and powerful action . . . when your diesel-starting battery is an Exide. It's built specifically for the job . . . all heavy-duty starting jobs. Years of experience in building diesel-starting batteries are back of it—continuous research-engineering development that keeps pace with engine builders' needs. In Exide Diesel-Starting Batteries you get:

QUICK BREAKAWAY and fast acceleration of engine to firing speed.

LOW DEPRECIATION due to their extra long life.

RUGGED CONSTRUCTION for rough usage in hard service.

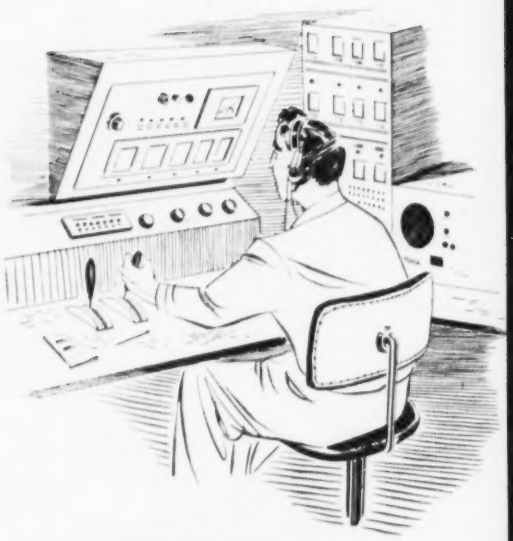
LOW COSTS of operation and maintenance.

Use Exide Diesel-Starting Batteries for all heavy-duty services—in buses, trucks, tractors, off-the-highway equipment, ships, power plants, diesel-electric locomotives.

WHEN IT'S AN Exide YOUR DIESELS START

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 2
Exide Batteries of Canada, Limited, Toronto
"EXIDE" *Reg. Trade-mark U.S. Pat. Off.*

1888 . . . DEPENDABLE BATTERIES FOR 64 YEARS . . . 1952



Wear Control

VAN DER HORST
TRADE MARK

Here's a proven way to bracket your Diesel cylinder wear costs and clamp them down to a minimum. The same can be done for compressors.

Just send your worn liners and cylinders to Van der Horst. If they've already been oversized to the limit, that doesn't matter. We can plate them all back to original bore dimensions with VANDERLOY M.

This pure electrolytic iron bonds atomically and can be developed a quarter of an inch thick, if that's essential.

Over the VANDERLOY M we plate PORUS-KROME*. It makes cylinders last as much as four times longer than they did when new and unprocessed.

Then, back they go, ready to give you efficient and dependable service, until at long last they need another Van der Horst processing.

Since the cost for all this is surprisingly less than the price for new, unprocessed replacements, we think you'll want to know more about our wear control method. Why not drop us a line? W52-1D

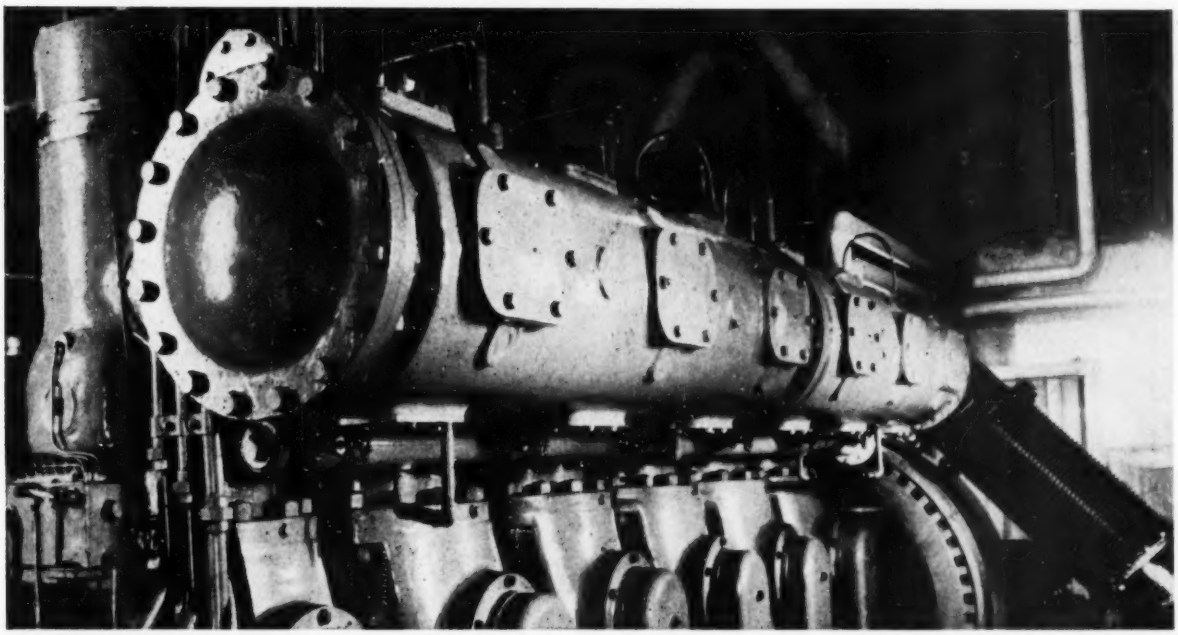
* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

U. S. PATENTS
2,048,578, 2,314,604 and 2,412,698

VAN DER HORST CORPORATION • OLEAN, N. Y.

INCREASING THE LIFE SPAN

OF EXHAUST LINES



American Flexible Steel Exhaust Hose was specified for this 450-H.P. Fairbanks-Morse Diesel Engine at a power plant in Jasper, Alberta, Canada.

This American Flexible Steel Hose is specially made to take day-in, day-out grind of heat, vibration, stress, and fumes.

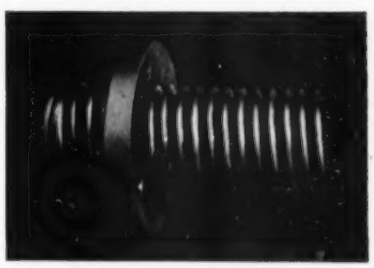
Repairs to diesel exhaust lines that have fatigued prematurely cost money. Engine down time due to flange bolts that have snapped is a dead loss. Replacing rigid pipes cracked by expansion takes time. It pays to consider carefully the life span of exhaust lines.

Check for flexibility and toughness. An exhaust line must stand up under vibration, pulsation, and extreme temperature variations for long periods of time.

Then check how easily the lines can be installed. Make sure it's gas-tight, and can "give" sufficiently with expansion and contraction to prevent broken castings and escaping gas fumes.

American Flexible Steel Exhaust and Air Intake Hose measures up to each of these exacting requirements. It is constructed of heavy corrugated flexible metal with flanges or fittings attached. It can easily be installed even where offset connections have to be matched. American Flexible Metal Hose adjusts to heat conditions and dampens vibration.

For original equipment or replacement, *specify* long-life *American Flexible Metal Hose* for Exhaust and Air Intake—also for your flexible line requirements for: starting air, circulating water, fuel oil, lubricating oil, etc. The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Co., Ltd. 52270



American Corrugated Steel Exhaust Hose made in such popular sizes as 6", 8", 10" I.D. Flanges to A.S.A. standards or various Navy Specifications are attached at our plant.

Write for copy of new informative booklet EH-50. It contains dimensions, weights, recommendations on American Flexible Metal Hose for exhaust, air intake, fuel, air, water connections, etc.

wherever connectors must move...

American ANACONDA from mine to consumer **FLEXIBLE METAL HOSE AND TUBING**

Hello, Young Voters!

You've taken this country as your birthplace.

You toddled around and laughed and grew under the sunshine skies of Liberty.

Your fathers and mothers put you to bed each night with the confidence of Freedom, not in furtive fear.

You learned in free schools.

You played ball or skated or jumped rope without a care in the world.

Your stomach was full, your clothes were warm, your roof was sound.

You enjoyed privileges and pleasures, movies and cars, treats and trips like no other youth growing up in the world ever did before.

Now you're of age.

You're full-fledged citizens.

Now it's your turn to pay with a little of your time and some of your thought for a lot of things you received when you were growing up.

The least you can do is to vote to help keep your country the way you want it, lest the children *you're* raising won't have the frank, free years you have had.

Be sure, Young Voters, you're registered!
Be sure, Young Voters, you vote!

Diesel Power &
Diesel Transportation

"Ring and Cylinder Wear... Way Below Average"

Says Supt. R. Carlson,
City of Saint Louis, Michigan

"Much of our Success is due to SINCLAIR GASCON OIL D"

The City of Saint Louis, Michigan, depends on diesels to furnish electric light and power... And Mr. Russel Carlson, Supt. of the Saint Louis power plant, depends on Sinclair GASCON OIL D to keep his large Nordberg and three large Fairbanks-Morse diesel engines humming 24 hours a day—with an absolute minimum of downtime.

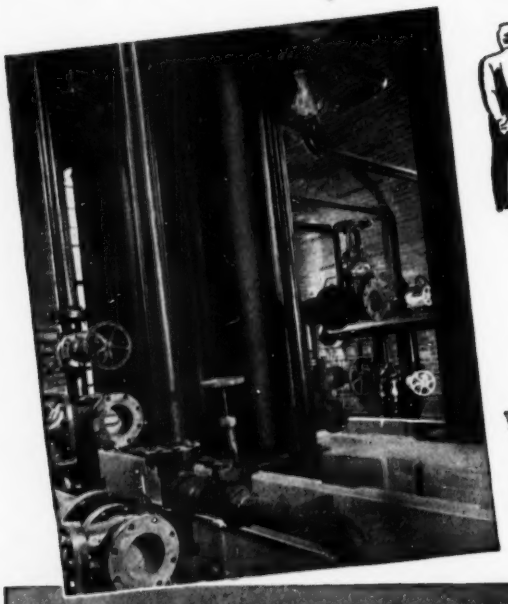
Says Mr. Carlson, "Experience has shown that our best results are obtained with Sinclair GASCON OIL D. Our engine cylinders and piston rings show minimum wear—in fact, *way below average*. We attribute much of our success to GASCON®."

Let Sinclair help reduce your engine wear. Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS
save wear and replacement

Dirty Water can't "Shut-down"...

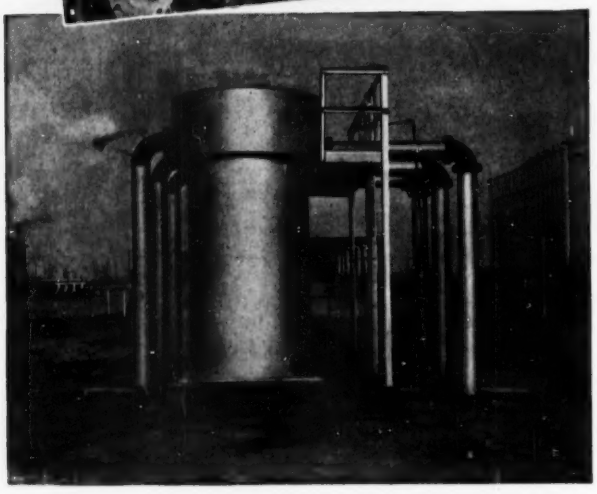
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424 441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

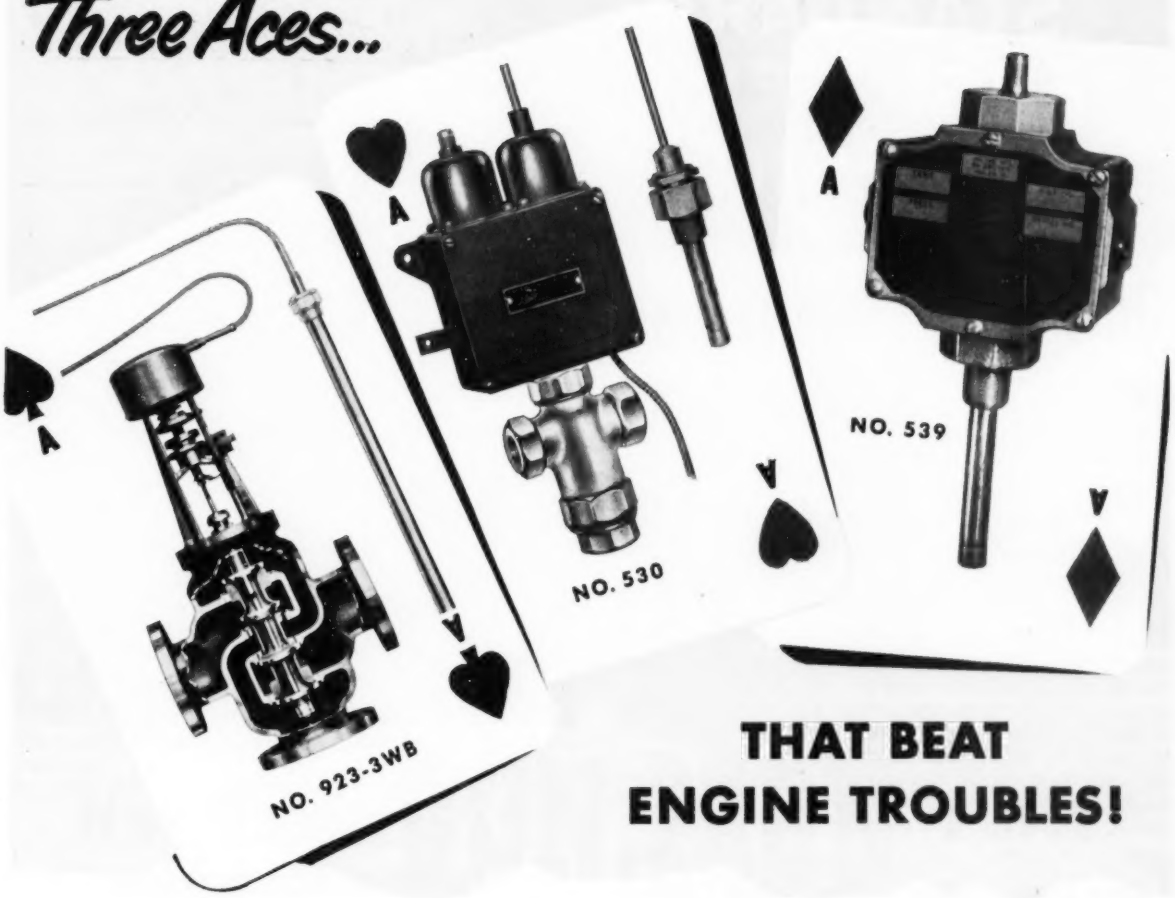
BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Three Aces...



THAT BEAT ENGINE TROUBLES!

YOUR ENGINES will be protected constantly—day and night—when you put these dependable Sylphon Controls to work. They assure accurate temperature control—and safeguard you against the risks of possible costly damage and shutdowns—help give your engines better lubrication—cut fuel and oil consumption.

Regulator No. 923-3WB controls temperature

Equipped with a 3-way valve which is automatically positioned to direct all or part of the water through a by-pass. It maintains constant volume of water through pump and engine . . . gives quick warm-up . . . improves performance.

No. 530 Safety Control stops the engine

It gives positive protection against high jacket water temperature and low lube oil pressure. If cooling water temperature goes above, or lube oil pressure goes below safe limits, the engine is immediately stopped. An outstanding feature of No. 530 is this: should the thermostat assembly develop a leak due to accidental injury, the safety control trips to the shutdown position. Available with alarm feature.

No. 539 Safety Control sounds an alarm

. . . to give you protection against overheating or low lube oil pressure. If water jacket temperature goes above, or lube oil pressure goes below the safe point, it sounds an alarm, flashes a warning light, or, if desired, shuts down engine operation. Fail-safe type.

Like all Sylphon Controls, these are sturdy and reliable, will give you years of trouble-free service. All are self-powered. For information, write for Bulletin RD-817.

FIRST WITH BELLOWS

Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON
DIVISION

ROBERTSHAW-FULTON CONTROLS CO. KNOXVILLE 4, TENN.

Canadian Representatives: Darling Brothers, Montreal

STANDARD ENGINEER'S REPORT

DATA

LUBRICANT RPM Delo Oils

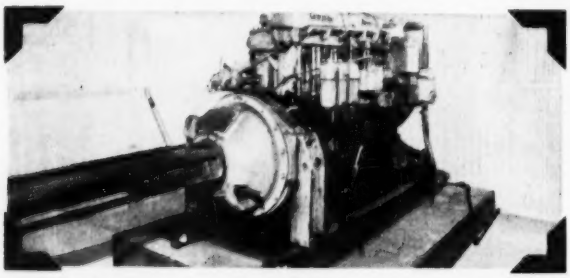
UNIT Caterpillar D13000 diesel

CONDITIONS Constant load

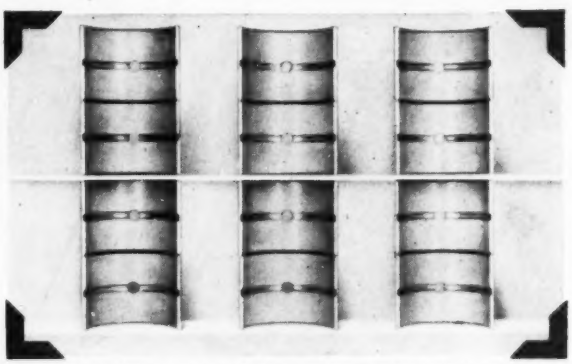
PERIOD 7650 hours

FIRM Dean H. Thayer, Mesa, Ariz.

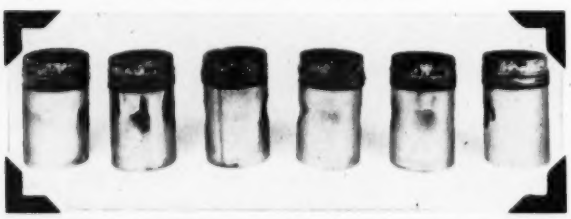
Only 0.001″ bearing wear in 7650 hours of work!



WORKING UNDER A CONSTANT LOAD pumping water, this D13000 diesel on the Dean H. Thayer ranch, Mesa, Arizona, ran 7650 hours before it was overhauled. An emergency made it necessary to run the engine for several days without safety cut-offs. Severe over-heating caused the governor to stick and the unattended engine reached a speed of approx. 1800 r.p.m. before it could be shut down.



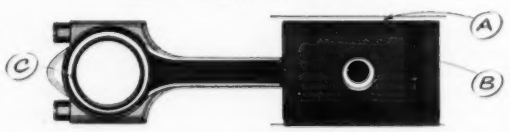
OPERATED ON RPM DELO Supercharged-2 Lubricating Oil during the 7650 hours, con rod bearings showed only 0.001" greatest wear. There was no pitting and all parts were unusually clean.



NO MEASURABLE WEAR was evident on the pistons which showed original tool marks. Greatest wear on liners was 0.005. Piston rings were all free, oil rings were open. After inspection, main bearings, crankshaft, cam & cam bearings, piston pins and bushings were all put back in service.

REMARKS: This engine operates year 'round in widely varying temperatures. In wintertime, the irrigation water is used to prevent the crops from freezing.

How RPM DELO Oils keep engines clean and prevent wear



A. Contain special additives that provide metal-adhesion qualities...keep oil on parts whether they are hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring-sticking. Detergent keeps parts clean, helps prevent scuffing.

C. Special compounds stop corrosion of any bearing metal, and oil foaming in both wet and dry sump engines.

There is an RPM DELO Oil to meet every heavy-duty engine operation condition. FREE BOOKLET on the RPM DELO Oils gives you complete information. Write or ask for it today.

RPM DELO LUBRICATING OILS

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

TRADEMARK "RPM DELO" REG. U.S. PAT. OFF.

STANDARD OIL COMPANY OF CALIFORNIA
225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY
P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS
P. O. Box 862 • El Paso, Texas

For Almost Half a Century

ROCK ISLAND Has Used GUN IRON Parts

As the Chicago, Rock Island & Pacific celebrates its 100th anniversary in October, a record of constant progress in providing the best in transportation will be widely recognized. On this fine railroad, every new advancement in equipment, operation, and maintenance methods has been quickly adopted to assure the most up-to-the-minute service to its passengers and customers.

It is a matter of pride to us that soon after Hunt-Spiller started to produce Gun Iron railroad replacement parts shortly after the turn of the century, the Rock Island became one of our customers. Since that time, many thousands of Gun Iron parts—cylinder liners, cylinder heads, packing-rings, etc.—have been used by this railroad . . . first in steam locomotives and now in its modern diesels.

On the other major railroads throughout the country, Gun Iron has also been accepted as one of the best materials available for parts subject to frictional wear . . . extreme pressure . . . high heat . . . resistance to corrosion and erosion. With new and improved products constantly being developed by Hunt-Spiller, it can be expected that parts made of Gun Iron will continue to be the first choice of the progressive railroads of the future.

A NEW CATALOG of Hunt-Spiller Diesel Parts is just off the press. Details of many parts currently being produced are shown. Write for your copy—no obligation, of course.

HUNT • SPILLER GUN IRON • AIR FURNACE PROCESS • HS-GI

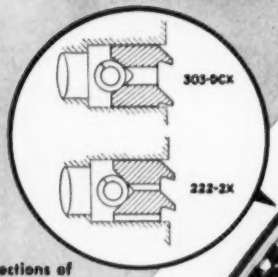
HUNT • SPILLER

MANUFACTURING CORPORATION

373 DORCHESTER AVENUE • SOUTH BOSTON 27, MASS.

Canadian Representatives: Joseph Robb & Co., Ltd., 4050 Namur St., Montreal 16, P. Q.

Why COOK "SUPER-FLEX" OIL CONTROL RINGS *reduce lube-oil consumption*



Sections of two typical rings.

Coil peripherial compression type expander, contained by the ring, simplifies application—fits existing grooves.

Straight-line oil flow, unrestricted by expander, assures maximum drainage.

Flexible ring section assures cylinder contact at all points—provides uniform and positive wiping action.

Tension is adjustable by inserting washers here.

Spring wire of rectangular cross-section gives expander stability—reduces localized stresses—assures uniform tension.

Ring and Expander Spring "float" in groove—cylinder contact is undisturbed by piston "slap".

Expander never touches groove lands or bottom—preventing damage to groove and expander.

COOK "SUPER-FLEX" OIL CONTROL RINGS

meet the crying demand for a more flexible ring that will conform to cylinder distortion and at the same time provide uniform wiping action all the way around the cylinder. Available in many styles to meet varying piston conditions, these advanced design oil rings reduce lube-oil consumption and maintain their efficacy throughout ring life. Write for recommendations job-engineered to your particular engine requirements. C. Lee Cook Mfg. Co., Incorporated, Louisville 3, Ky. Representatives in principal industrial cities.

COOK
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

DIESEL POWER
AND DIESEL TRANSPORTATION

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September, 1952

Vol. 20, No. 8

Cover Photo: Lining up for the charge, an International TD-24 equipped with a "Stump Splitter" prepares to rip a huge stump in half so that it can be easily pushed out of the ground by the big crawler.

EDITORIAL

Nationalization—A Growing Threat 29

SPECIAL FEATURE

Light Weight Packard Diesel 36
Another development by the Packard Motor Car Co.: two light weight high-speed engines constructed almost entirely of aluminum, with maximum parts interchangeability.

ARTICLES

Space-Saving Through Higher Speeds 32
Farming With Diesels 39
Heavy Shop Conversion—Steam to Diesel 40
Shaft Currents in Engine Driven Generators 48
Two-Unit Switcher Has 3200 Hp. 53
Engine Preheating 54
Fundamentals of the Diesel-Electric Locomotive, Part III 56

DEPARTMENTS

Highlights 31
Washington Slant 35
Diesel Briefs 46
What Do You Know! 55
Straight From the Tool Box 60
New Products 62
Field Notes 72
Advertisers' Index 86

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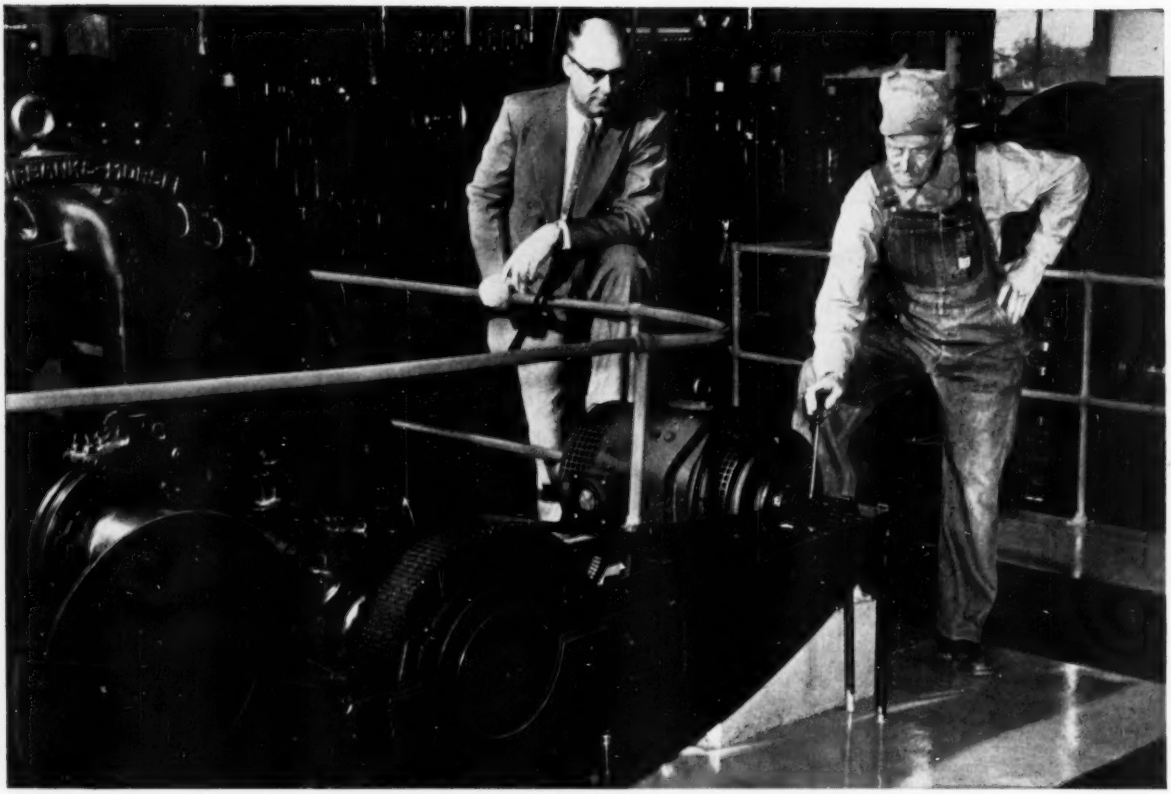


Link-Belt Silent Chain Drive operates the exciter on this 840 kw Fairbanks-Morse generator in Kansas. Two other drives operate at 375 kw and 781 kw.

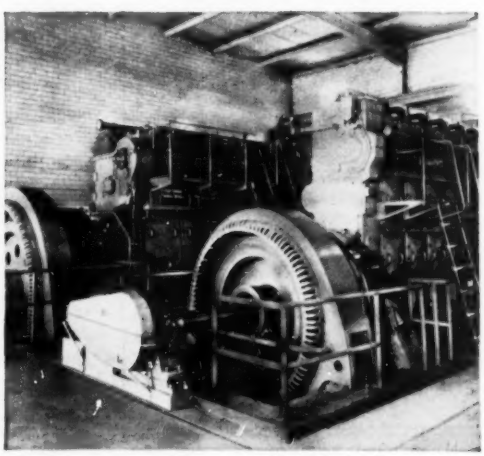
LINK-BELT Silent Chain Drives transmit full exciter rpm

Positive tooth-to-tooth action provides exact ratios for drives which give long, efficient service on diesel auxiliary drives

LINK-BELT Silverstreak Silent Chain does not rely on tension for its pulling power. The chain meshes with the sprocket teeth —gives you a positive drive—no slippage.

That's one big reason why so many diesel-generators have Link-Belt Silent Chain exciter drives. Another is its compact, all-metal construction. The long life of Silverstreak Silent Chain is a matter of record. Twenty-five years' service—with no maintenance other than routine lubrication—is regularly achieved.

If you're installing exciter or any other diesel auxiliary drives —check up on Link-Belt Silent Chain. There's an experienced power transmission engineer in the Link-Belt office near you.



At this Iowa station, the Link-Belt Silent Chain Exciter Drive transmits full rpm to a 1600 kw Elliot generator.

LINK-BELT

SILVERSTREAK SILENT CHAIN DRIVES

LINK-BELT COMPANY—Plants: Chicago, Indianapolis, Philadelphia, Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 12,088

Editorially Speaking . . . .

Nationalization - A Growing Threat

NATIONALIZATION is affecting every one of us — right now, principally in the pocketbook. We have paid in one way or another for Englishmen's wigs and teeth and for the oil no one is getting from Iran. From the way it looks, we are now going to have to buy Iran out of the Reds' hands.

You would think that with all these precedents, our government would shun nationalization as a plague. Reason and logic to the contrary, such is not the case. There are increasing governmental incursions into private industry—either directly, as in the power field; by seizure, as in the case of the railroads and as tried with the steel mills; or through onerous regulation and taxation.

For years it has been the consensus that the power and light people were headed straight for governmental ownership. They are still threatened: All you have to do is to hear the President's speeches referring to power companies as "forces of reaction", exacting a "toll" from the people.

Nationalization here, is of direct concern to our industry. Answer this question, "What will be the fate of municipals, cooperatives and REA plants, and how long will they be allowed to operate in competition with a big governmental monopoly?" This goes for some industrial installations too.

As if this was not bad enough, we have the word of the Transportation Association of America, the Brookings Institute, and agreement by the utilities that the railroads are closer to nationalization than the power industry. Diesels have helped to stave off the fateful day, since the "lever" to be used is economics.

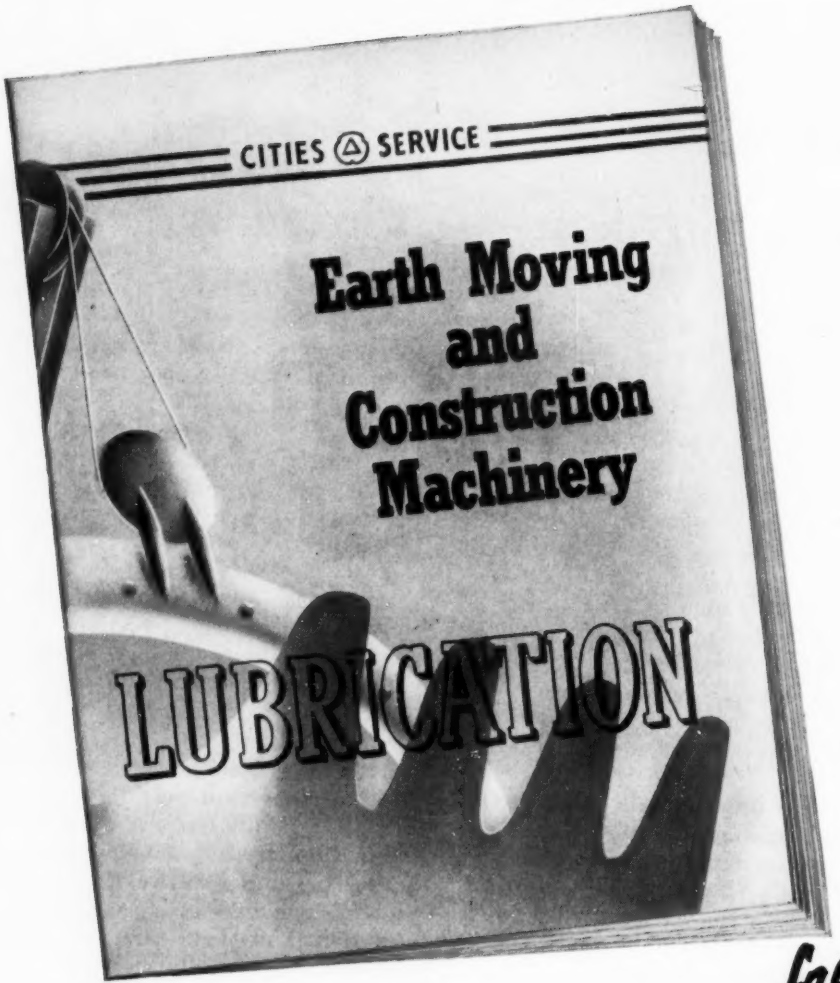
Class I railroads, with total investments of over 25½ billions (three times that of the steel industry), earned only 3.7 per cent on their investment in 1951. Traffic for the same year was over 643-billion revenue ton-miles, a total only exceeded in 1947. Such earnings during good times will not attract the investment capital needed by the railroads for expansion to meet the nation's requirements.

Caught between fixed rates and rising costs, the railroads are in a bad way for the long pull, despite heavy investments for efficient equipment to reduce costs. Working capital is one-fourth as large as six years ago and only half as large as one year ago. Railroads say that even a slight business recession, causing reduction in freight volume, could bring widespread bankruptcy.

Why? Because railroads are "the most highly regulated of all industrial and commercial properties . . . " Railroads once had a virtual monopoly on transportation and some regulation was needed. Today, competition from 8,500,000 trucks, 27,300 miles of inland waterways, a 142,000-mile pipeline network, mushrooming air transportation, buses and cars, will force rates into line.

Regulations must be altered. The alternative is eventual bankruptcy. Then comes heavy subsidy or outright nationalization. This must not be allowed to happen!

We all stand to lose — financially and in basic freedoms. Business must have the right to exercise the judgment and initiative that made our nation great.



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+ HIGHLIGHTS +

● The United States Army Transportation Corps has ordered adjustable gauge diesel locomotives. The locomotives are designed to run on any gauge track from the United States standard of 4 ft 8½ in up to 5 ft 6 in.

● Railroad expenditures for new construction during the first four months of 1952 totaled $119,000,000, as in comparison with $101,000,000 for the same period of 1951.

● During the past six months, electric power capability has increased by about 2 million kw.

● Defense expenditures now account for about 15 per cent of the total value of all goods and services produced and for a substantially higher proportion of total manufacturing production.

● A total of 3,912,228 barrels of fuel oil were consumed during June of this year. This was 13.9 per cent below the 4,544,235 barrels consumed in June 1951.

● Atomic energy, our future source of power, must still rely on the use of diesel power to a large extent for standby, reports from the AEC indicate.

● According to recent reports, railway purchases of iron and steel products last year totaled $704,000,000. This amounts to more than $2,300,000 for every working day.

● Natural gas is now a commodity for import and export. The Tenessee Gas Transmission Company, Houston, Texas and Niagara Gas Transmission Limited, Toronto, Canada, have applied to the FPC for authority to export gas for use in eastern Ontario. Other proposals involve plans to import gas from Canada for use in Pacific Northwest and Midwest.

● Production of primary aluminum increased by 100,000 tons during the first six months of this year.

● There are 11 straight stretches of railway track, 50 miles or more in length in the United States. North Carolina boasts the longest, almost 80 miles.

● During the month of June 1952, 401,177 barrels of fuel oil were consumed by internal combustion plants in the production of electric energy.

● The Canadian National Railroad has recently put in service a twin-unit diesel-electric locomotive with a hauling capacity of 4000 tons.

● State and federal gasoline tax collections will shatter all records this year, The American Petroleum Industries Committee predicts, estimating that combined receipts will exceed $2.75 billion. Prediction is based on six months' receipts showing a 10 per cent increase. O.K., now let's have some adequate roads.

● Recently, the American Society of Naval Engineers compiled almost all known methods of saving tin in one handy format. Copies are available from the Bureau of Ships.

● The FPC announced that as of July 1, 1952, 13,194,365 barrels of fuel oil was on hand as compared with 11,397,260 barrels the previous July 1.

● In a recent report, W. G. Vollmer, President of the Texas and Pacific Railway, stated that dieselization of all service on the system was completed in April. He said that fuel costs for the road were cut by more than 50 per cent in the first six months of this year as compared with the cost of fuel for steam operation.

● Twenty-four books a year are read by the average scientist, the American Chemical Society reports. He plays one musical instrument and speaks one foreign language.

● As of July 1, 1952 there were some 37,790 domestic freight cars on order and undelivered, reflecting to some extent the effect of the steel strike.

● The U. S. aluminum industry produced 17 per cent more during the first half of 1952 than it did in the first six months of 1943, peak production year of World War II.

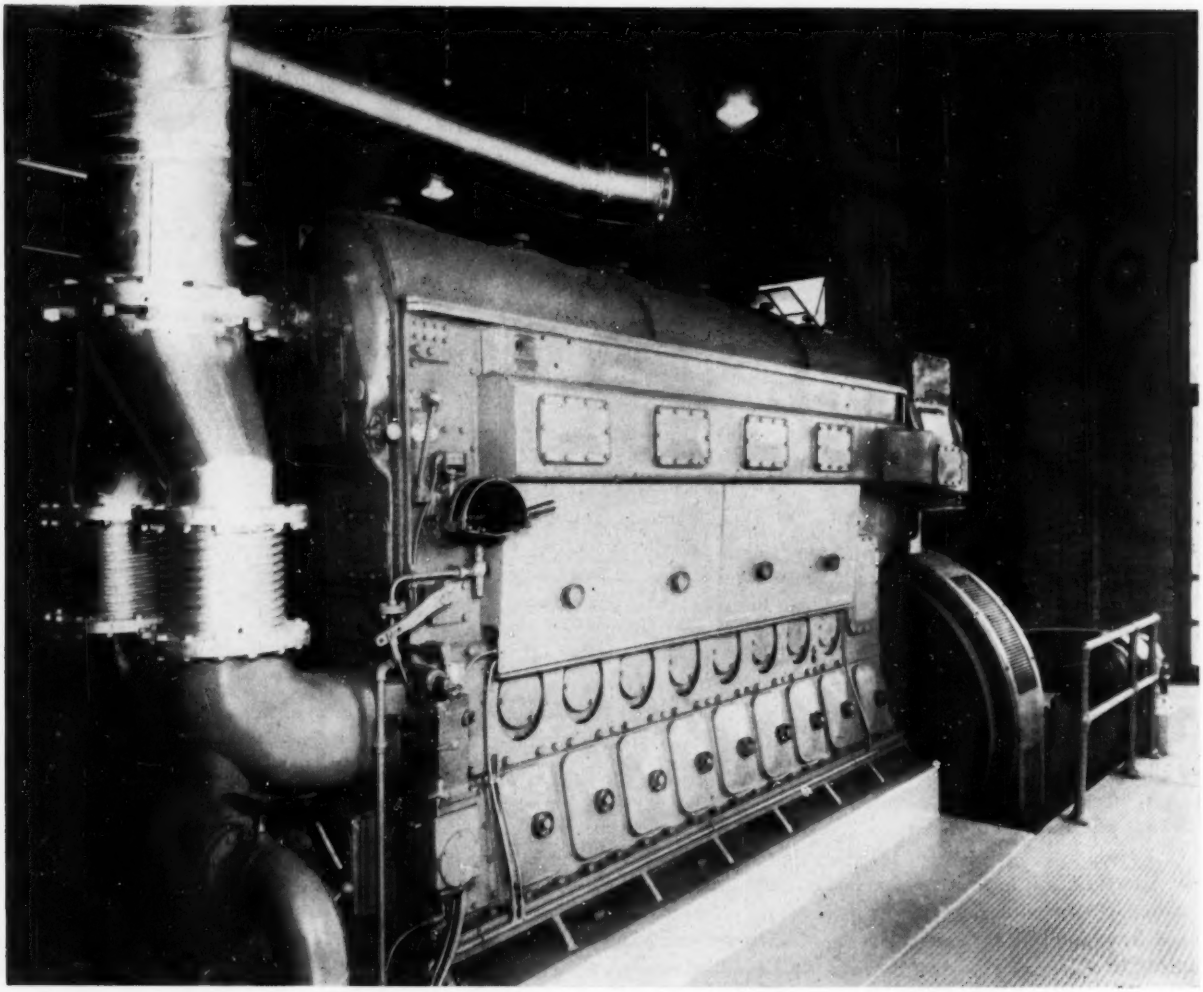
● July deliveries of new domestic freight cars totaled 5,402 compared with 6,411 in June of this year and with 5,290 in July 1951. Backlog on order as of August 1 was 95,265.

● According to the FPC, fuel oil consumption during the month of May totaled 3,716,715 barrels.

● Railroad operating revenues increased 1.7 per cent and operating expenses increased 0.9 per cent in the first six months of this year.

● More than 300 liquids, gases, and solids are carried in railroad tank cars. To accommodate these various commodities, as many as 83 different linings must be built into tank cars as each commodity requires a certain type of tank lining.

● Railroads as part of a cooperative effort came to the rescue of the farmers. Steel strike cut tin plate available for cans and threatened serious loss of crops. NPA sought and obtained cooperation of steel companies, can manufacturers, Association of American Railroads, and the railroads themselves. Diesels will speed cans to the packing plants in time to save perishable crops.



Space-Saving Through Higher Speed

By
R. E. Barret, Mechanical Engineer
and G. F. Fisher, Electrical Engineer
Stanley Engineering Company

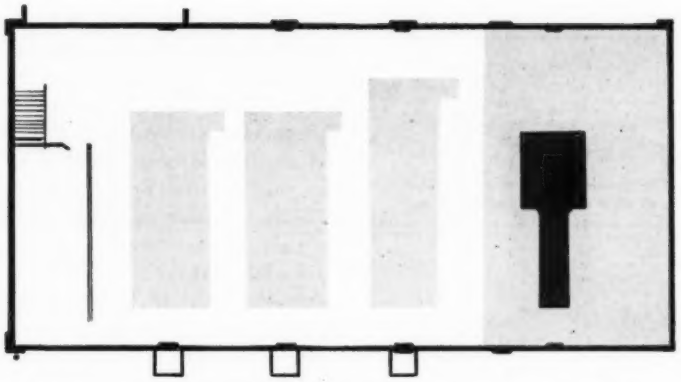
Compact engines—operating at higher speeds—are becoming more common every day. Here is a typical installation of a 703 kw engine-generator set in municipal service operating at 514 rpm and taking up less space.

THE Town of Cascade, although small and with no major industry, has supported an electrical plant for the last 55 years.

In 1897, a private utility company built a steam plant consisting of a single cylinder steam engine driving a 25 kw, 1100-volt, single-phase, 60-cycle generator. This private utility plant was run in connection with the City's water plant which was started in the year of 1895. During the day, the city water supply was pumped; generation of electricity starting at dusk and the plant was secured at 11:00 in the evening.

In the year 1916 the first electric refrigeration came to Cascade which necessitated a 24 hr supply of electricity. Consequently, the utility built a small hydro plant in connection with the construction of a flour mill. This hydro plant was built on the north fork of the Maquoketa River which runs directly through the center of the Town. In 1921, the Cascade Electric Light and Power Company sold their holdings to the Iowa Electric Company in Cedar Rapids, Iowa. This utility supplied the electricity for the Town until June of 1940.

The municipal electric system had its beginning in 1939 with a bond issue of $61,000 financing the construction of a new plant consisting



It will be noted in the illustration above that the new engine requires much less space than either of the three older engines.

of two Fairbanks, Morse diesel generating units rated at 200 kw each, and the acquisition of the existing electrical distribution system in the town. With the institution of a municipal plant, electric rates were reduced approximately 10 per cent in the belief that reduced rates would increase electrical energy consumption.

By 1948 peak loads had approximately doubled and the annual generation of energy was more than twice that of 1940. This brought about the addition of a third diesel generating unit of 300-kw capacity together with additional service facilities required for its operation. Space had been provided in the original plant for the installation of this unit with its necessary auxiliaries. The third unit extension was financed by funds on hand together with a new bond issue of $55,000.

In 1949, only nine years after its construction, the plant had retired the original bond issue. The sales program put on by the municipal electric plant through reduced rates, together with the fact that gas is not available as an alternate for use by its customers, greatly increased the annual consumption of electrical energy as well as the peak demand. By 1950, the loads were up another 50 per cent above 1948. This led to the 1951 extension for the fourth unit.

After comprehensive studies of the past and probable future load growth, together with analysis of economical unit size, the Stanley Engineering Company designed the 1951 plant extension and prepared plans and specifications for its construction.

Inasmuch as the Town of Cascade is a small town and large investment funds were not available every few years for additions to the plant, it was deemed advisable and most economical to add a unit of around 600 to 700-kw capacity.

One of the unique features of the 1951 extension is the installation of the 514-rpm Fairbanks-Morse opposed piston, 8-cyl engine with a 703-kw, 2400-volt generator with a chain driven exciter. Similar engines had considerable application in submarines and other naval craft during the second world war and also in the railroad service. However, this was the first installation in the State of Iowa of this particular engine rated at 514 rpm. It will be noted that 514 rpm is considerably over the heretofore generally recognized conservative range of between 257 and 360 rpm.

Some operators may consider that for municipal electric service this is a rather high speed. However, the Board of Trustees believed their choice was justified in view of the record that this diesel engine had in naval installations and in railway service, operating at even higher speeds than were being used on this particular installation. Although the engine operates at a rotative speed in excess of the heavy duty type, which is in use in the majority of installations of this type, the piston speed is below 1200 fpm due to the short stroke of the engine.

A desirable feature of this engine is that it requires approximately half as much floor space as a conventional slow speed engine of the same hp rating. Also appealing to a small municipal electric plant is the low initial investment required for the engine plus the reduction in size of the building extension necessary to house the unit. This unit of 703-kw capacity was obtained for a total cost including engine, generator, mechanical work, electrical work and building extension of approximately $125 per kw installed.

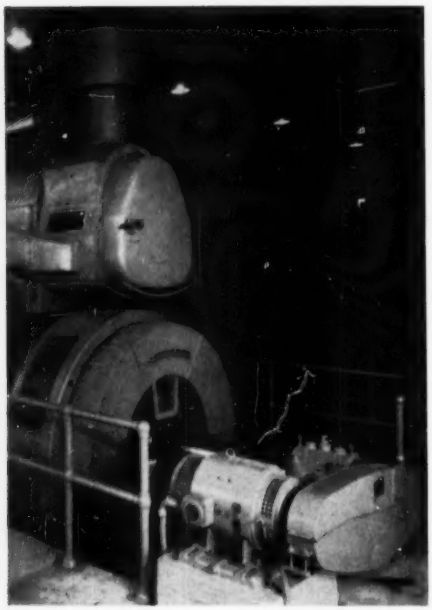
Plant Design

The plant arrangement provides for drawing the engine intake air through an intake on the south side of the building with the air passing through a viscous impingement-type filter on its way to the engine. The engine exhaust passes from the water-cooled manifold through corrugated expansion joints to the exhaust silencer located outside the building on the south side.

The heat from the exhaust silencer of the latest unit is not used for heating the building. It was determined that all of the necessary heat could be obtained from the existing three units. This is accomplished by the exhaust heat recovery system of these units and from direct radiation from the engines in operation. Heating of the office is accomplished by unit heaters with jacket water circulation.

Due to the high operating temperatures of the lube oil and jacket water on this new unit, the jacket water system is separate from the existing system. The jacket water of the existing three units is cooled in tubes of the cooling tower. For the fourth unit system, the jacket water of the old system is used to cool the lube oil and jacket water of the new engine. Both jacket water and spray water are provided through a zeolite softener.

The engine lubrication for the first three units involves the use of a straight mineral oil. The lubricating oil used for the new engine is a detergent type oil. It is circulated continuously through a cellulose cartridge type filter during the operation of the engine by bleeding a part of the en-



The generator end of the 703 kw unit illustrating the position of the chain driven exciter.

gine driven circulating pump discharge through a regulating orifice in the small filter line.

An electric motor driven "Before and After" lubricating oil pump is installed in conjunction with this fourth unit. This pump can be used for circulating oil before starting the unit, after stopping the unit, and in emergency for short periods on failure of the normal pump. The lubricating oil is cooled by means of a shell and tube type heat exchanger through which the cooling water of the first three units is circulated before it enters the natural draft cooling tower.

Fuel oil is stored adjacent to the plant and is pumped to the fuel oil day tanks from which it flows, by gravity, to each of the three original engines. Oil is forced, by an engine driven pump, to the fourth unit from the day tank located in an enlarged pipe trench.

Compressed air starting is provided for all engines in the plant. This system, operating at 250 psi, includes two air tanks and a dual drive compressor in the basement which were provided with the initial units. A new storage tank was installed in conjunction with the last extension.

The switchboard provided in the original plant consisted of a conventional dead front, open type switchboard together with bell crank operated oil circuit breakers and a 2400 volt bus structure. This switchboard and bus structure was found satisfactory for extension to accommodate the generator panel and a new feeder panel which were installed to match existing equipment. The existing station service transformers were found to be inadequate to handle the additional load and were replaced by larger transformers.

An engine control panel was provided with the new engine and centralizes all controls for engine auxiliaries as well as providing a convenient location for the necessary gauges and alarm system. Alarms are provided for high jacket water temperature, low jacket water pressure, high lubricating oil temperature, low lubricating oil pressure and high fuel oil tank level.

Operation

The three existing engines in the plant generate approximately 12 kwhr of energy per gal of fuel oil consumed. The total operating cost of the plant including maintenance, labor, fuel oil, lubricating oil and supplies averages between 1.6¢ and 1.9¢ per kwhr. Although extensive cost records are not yet available on the operation of the new engine, the Board of Trustees believes that this cost per kwhr will be reduced considerably. This is due to the fact that the new engine is running well over 13 kwhr per gal of fuel oil consumed at the present time with an average load factor of less than 50 per cent.

A typical month was January 1952 which shows an average load on this new unit of 292 kw with a generation of 13.48 gross kwhr per gal of fuel oil. The plant uses straight distillate fuel oil, crude oil being rather difficult to obtain due to the absence of railroad facilities at Cascade. The lubricating oil consumption of this new engine is currently 2/3 less than the consumption of each of the existing three units.

The municipal plant furnishes the Town of Cascade all of the electricity consumed by the City's street lights, etc., at a reduced rate. The savings to the city at this reduced rate amounts to between $1000 and $1500 a year.

The excellent operation of Cascade's plant is indicated by the fact that, since its construction in 1940, the total plant outage has been only 15 minutes.

Management and Engineering

A three man Board of Trustees manage the municipal system, establish the policies, and through the town's superintendent of utilities, Mr. Frank Otting, supervise operation of the system.

Engineering of the original system and the two extensions, including preliminary studies, design, and supervision of construction, has been performed by the Stanley Engineering Company of Muscatine, Iowa.

Principal Equipment

Engine	Fairbanks, Morse & Company
Generator and Exciter	Fairbanks, Morse & Company
Governor	Woodward Governor Company
Lube Oil Cooler	Ross Heater & Manufacturing Company
Lube Oil Filter	U. S. Hoffman Machinery Corporation
Water Pumps	Fairbanks, Morse & Company
Air Intake Filter	Air-Maze Corporation, Inc.
Exhaust Silencer	Burgess Manning Company
Building Construction	John Becker
Electrical Construction	E. A. Pedersen Company

Washington Slant

NPA POST-STRIKE STEEL PROGRAM has been defined in terms of military and non-military production. In the former category: (1) preferential status is given to fulfill outstanding 2nd and 3rd Quarter orders; (2) set-asides have been made for meeting 4th Quarter deliveries; (3) CMP Reg. 2 was revised to provide 30-day inventories; (4) NPA Order M-6A was revised to aid small lot users; and (5) Dir. 4 to CMP Reg. 3 was revised to speed Class A and B deliveries.

NON-MILITARY PRODUCTION received the following rules: (1) present 2nd, 3rd, and 4th Quarter allotments stand; (2) priority of carry-over orders to stand; (3) 1st Quarter, 1953, allotments to balance supply and demand; (4) unplaced 3rd Quarter "tickets" good for deliveries through November, 1952 ; (5) 4th Quarter "tickets" good for deliveries through February, 1953.

EMD'S APPEAL ON NEW FORMULA PERCENTAGES has been turned down. Original formula was: EMD—59.4 per cent; Alco—23.5 per cent; Baldwin-Lima-Hamilton—12.9 per cent; and Fairbanks-Morse—4.2 per cent. EMD contended that during the base period (1948 through 1950) they spent $35,000,000 to expand their productive facilities about 75 per cent while others expanded only about 24 per cent. Base period was held unrealistic for the rapidly moving industry. Also, they contended that at no time had they been able to produce 59.4 per cent, although facilities were available, because of insufficient allotments. Current allotments cause prospect of releasing 3000 workers in 4th Quarter.

NEW FORMULA PERCENTAGES apply to builders of diesel locomotives for all users; domestic, industrial and export. Nine companies are involved and the four majors' material cut is reduced. New percentages follow: EMD—51.4 per cent; Alco—21.7 per cent; B-L-H—11.9 per cent; F-M—3.6 per cent; G-E—7.8 per cent; Whitcomb—2.4 per cent; Davenport—1.1 per cent; Vulcan—0.06 per cent; and Plymouth—0.04 per cent.

MEANWHILE, INTERIM EXPANSION PROGRAM for production facilities for railroad equipment to be completed or installed between January 1, 1950 and January 1, 1954, has been set at $30 million with certificates of necessity for $20 million issued as of July 15, 1952. Included in this program are facilities for producing diesel locomotives. We have the capacity practically across the board in the firms listed above. All they want is the materials. The whole thing doesn't make sense.

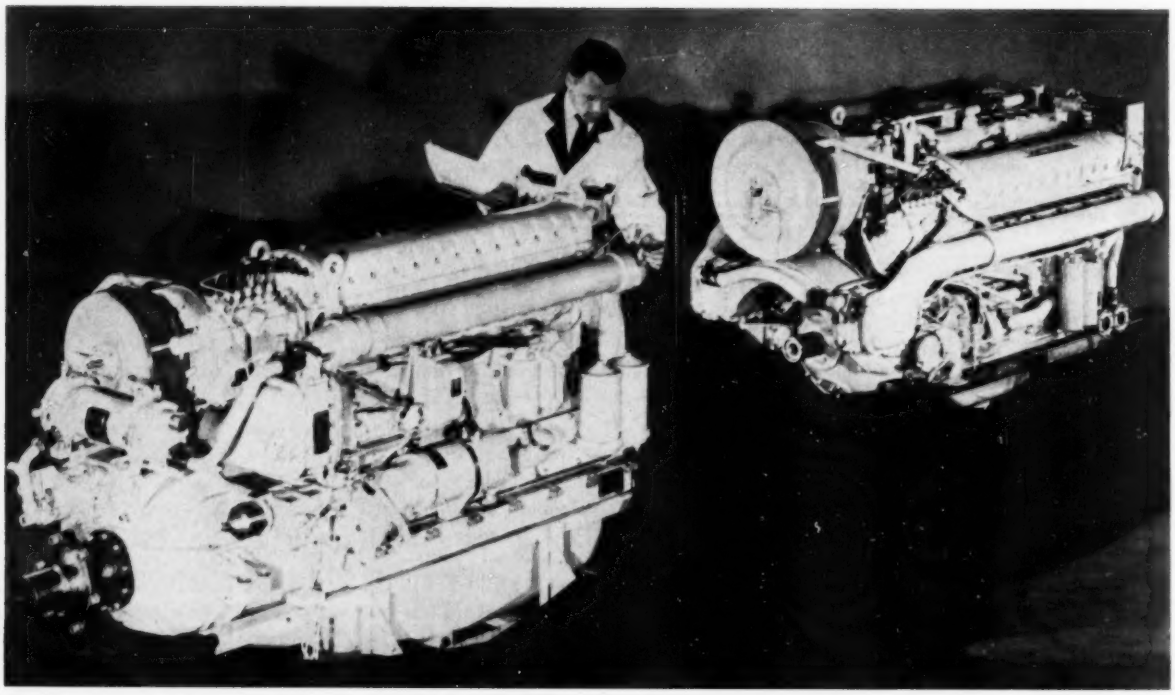
STUDY OF POST-DEFENSE MARKETS has been initiated in the Dept. of Commerce. Pattern of project is similar to that undertaken in 1943. Peak production in defense build-up is expected in mid-1953 and economists are to base study on probable conditions and problems existing after that date. Purpose is to aid employers in preparing production and marketing plans to give maximum employment and high productivity after emergency. Last study is reported as being fairly accurate.

CRAWLER-TYPE TRACTOR INTERIM EXPANSION PROGRAM has been set at $85 million capital investment by January 1, 1954, above that of January 1, 1951. Rapid tax amortization certificates have been issued for 90 per cent of goal. Small business (2500 employees or less) has been allotted 8 per cent. This will principally apply to the manufacture of tractor attachments.

METAL CONSERVATION IN CONSTRUCTION MACHINERY is reported by three of the larger builders. International-Harvester reports savings in critical nickel and molybdenum of 79 and 72 per cent respectively. Use of relatively new chromium-boron steels helped. Caterpillar reports savings of 77 lb of nickel in each D8. A 10-year program has resulted in nickel savings of almost 12,000 ton. Substitution for brass and copper in radiators is still experimental with progress in aluminum use. Corrosion-inhibited steel radiators are also under test. Allis-Chalmers reports reductions of up to 27 per cent in copper and brass for radiators through reduction of thicknesses and number of fins per inch.

MOTOR TRUCK IAC advised NPA that production levels for 1st Quarter, 1953, should be upped 350,000 units. June domestic sales and production for export were: light—55,907; medium—26,687; and heavy—10,781. Distribution of controlled materials for 275,000 of 285,000 units authorized for 4th Quarter have been made and supplementary tickets for the reserve of 10,000 trucks is to be issued.

WATER IS CRITICAL FOR DEFENSE and stoppage of defense production for lack of water in several instances was stressed in a recent report. NPA Water Resources Division limited allocation of materials to most vital projects according to a 9-category criteria of preference. Sewage disposal projects are high. Ability of diesel plants to produce power with practically no major water requirements should be an asset, and dual-fuels are a "natural" for sewage disposal plants.



Above are the two recently developed, light-weight Packard diesel engines. The one at the left being a 6-cyl in-line and the engine at the right a 60 deg V-12. The engines were developed simultaneously under a $90 million Navy contract.

Light Weight Packard Diesel

Here is a good example of more power in smaller and lighter packages with the added advantages of parts being interchangeable between 6-cyl in-line and V-12 engines.

USING aluminum in place of cast iron and steel, the Packard Motor Car Company has recently introduced two light-weight, high-speed engines. The two models, referred to as Series 142, are at the present time in production for the US Navy.

The engines are of the four-cycle industrial type, with one being a 6-cyl in-line and the other a V-12. Equipped with turbochargers, ratings are 300 and 600 hp respectively for continuous operation at 2000 rpm. By using aluminum in the construction of these engines, the power-to-weight ratio has been greatly reduced. The 6-cyl model tips the scales at 2200 lb while the V-12 weighs 3250 lb. This puts the weight of the Six at 7.34 lb per bhp and that of the V-12 at only 5.41 lb per bhp.

At present, the production of these engines is being absorbed by the Navy. However, Packard plans to reenter the marine engine business some time in the near future. In addition to marine use, these light-weight engines should find many other applications such as small industrial power units, large trucks and buses, and off-highway vehicles.

During the design period, a system for interchanging parts was developed. Most of the major parts are interchangeable among the engines. This is a big step toward greater economy and ease of servicing. For example, the basic cylinder assembly which has been adopted is standardized for both models.

Some of the major parts interchangeable between models are: cylinder head and wet liner assembly (integral on these engines); pistons, piston pins, and piston rings; intake and exhaust valves, valve springs and guides; main and camshaft bearings; and other minor parts. In addition, crankshafts on both the 6-cyl and V-12 engines are interchangeable, as are the fuel injectors and fuel injection pumps.

A spherical precombustion chamber provided with a removable multiple orifice burner is precision-cast in the alloy steel cylinder head. The precombustion chamber is

located directly over the piston, and designed to eject the hot gases on to the dome of the piston. Metered quantities of fuel are injected into the precombustion chamber by a pintle type fuel injector. Here, the fuel ignites and peak pressures occur.

The burning mixture is then ejected into the main combustion chamber over the conically shaped piston dome. The cone shaped piston dome disperses the high velocity jet causing it to mushroom. This results in high turbulence and thorough mixing of fuel. Thus, complete clean burning of fuel is obtained.

As with most precombustion chambers, the peak firing pressures are contained in the reenforced energy cell. This means that firing pressures in the main combustion chamber are generally lower and permits the use of lighter material in main combustion chamber construction, as well as the use of lower fuel line pressures to the injectors.

The fuel injection pumps for both engines are of the multi-plunger, constant-stroke, port and helix metering design. Each plunger has a double helix to provide a variable beginning and end of injection. Fuel pumps of the 6-cyl type are used on both engines. The 6-cyl in-line engine requires only one of these units while the V-12 uses one per bank. Fuel is governed by an externally mounted hydraulic governor. As an added safety measure, an over speed trip governor has been installed.

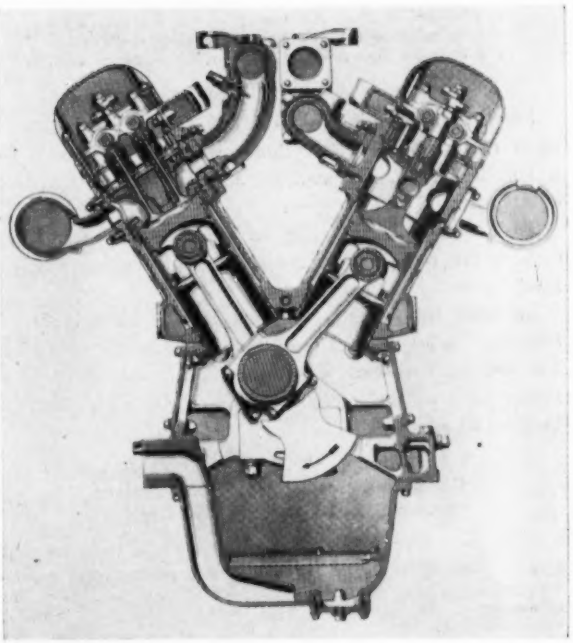
As previously mentioned, aluminum is used to the maximum extent in the construction of these engines. The cylinder block and crankcase are integrally cast of aluminum. Some of the other aluminum parts are: oil pan, valve covers, timing gear cover, supercharger, intake and exhaust manifolds, accessory housing and cover plates, pistons, and other detail parts.

To assure rigidity, the cylinder block has traverse bulkheads at each main bearing. Long through-bolts which extend through the main bearing caps to external bosses, tie the caps to the block.

Precision castings of alloy steel are used for the cylinder heads. The heads are cylindrical in shape and fit into the bores at the top of the block. A threaded ring nut holds the wet-type cylinder liner and heads in place. As mentioned earlier, the liners and heads are welded together to form an integral part which is easily replaced.

Each cylinder head is fitted with two intake and two exhaust valves, which are driven by individual camshafts —two per bank. Valve seats and faces are hard-surfaced with stellite. The exhaust valves are sodium cooled. The nested valve springs are of the damping type, and are caged in cylindrical barrel which is integral with the valve guides. Barrel type tappets fit over the springs and slide within the valve guide barrel. Valve clearance adjustment is provided for by the use of a button, which fits over the valve tip and contacts the inner face of the tappet.

Permanent mold aluminum alloy pistons with a formed dome cavity are fitted with five rings. Four of the rings (three compression and one oil control) are located above the piston pin with the fifth ring just above the lower edge of the skirt. Of the three top compression rings, the first is chrome plated and the next two are of the tapered face type. The two remaining rings are double-land oil control rings.



This illustration of the V-12 engine shows the compactly engineered valve, pre-combustion chamber and piston. The integral head and cylinder liner assemblies are interchangeable as complete units. Crankshafts are made in both magnetic and non-magnetic types.

The counterweighted and fully balanced crankshaft is an alloy steel drop forging and is nitrided for longer life. Steel-backed main bearings of the interchangeable type have a silver bearing coating on the steel. A thin lead-tin coating is also used to protect the silver bearing from scuffing and corrosion.

A viscous fluid vibration damper is fitted to the crankshaft. To reduce weight, both the connecting rod journals and main journals have been hollow-bored. Connecting rods are constructed of drop forged steel. The fork and blade type connecting rod is used in the V-12 engine.

Turbochargers are mounted at the front of the engines and fitted with air cleaners. A special smooth-flow exhaust manifold directs the exhaust gases to the turbine end of the supercharger. This manifold is water jacketed to reduce the radiation of heat from the engine. A special design is used here to compensate for the heat losses in the exhaust gas stream to the turbocharger. This is accomplished by the use of a stainless steel tube in the manifold. The diameter of the tube is such that a dead air space is provided between the inner surface of the cast manifold and the tube.

In addition, exhaust manifolds are grouped in order to prevent blow-back when scavenging and aid in concentrating the velocity of gases to the turbocharger at low speeds. A compact heat exchanger which is located between the intake manifold and the turbocharger aftercools the intake air. The V-12 engines require two of these aftercoolers as one is used for each bank.

If produced in steel, this casting of the accessory drive housing which is used on the V-12 engine, would weigh 140 lb, more than twice as much as the aluminum used.

Pressure lubrication is provided to all bearings and other major points. The cylinder walls are lubricated by a splash system. Oil coolers and filters are standard equipment.

To assure quick starting in cold weather the Navy engines are equipped with air operated starting motors. Electric starters can also be used.

At some future date, Packard intends to develop an 8-cyl and a 60 deg V-16 of the same design using the 142 cu. in. cylinder. When this is accomplished, most major parts will be interchangeable among all the engines in the 142 series.

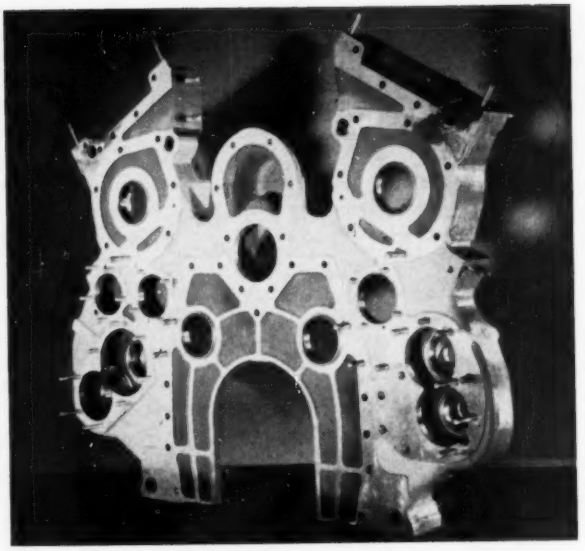
Condensed Mechanical Specifications Packard Series 142 Diesel Engines

	Six	V-12 (60 Deg.)
Type	Four Cycle, compression ignition, with precombustion chamber	
Bore (in)	5-3/8	5-3/8
Stroke (in)	6-1/4	6-1/4
Displacement (cu in)	852	1704
Compression Ration	15 to 1	15 to 1
Rated Speed (rpm) continuous	2000	2000
Rated bhp, continuous duty (supercharged)	300	600
Power take-off	Flywheel and flywheel housing on engines with gear boxes and generators. Hydraulically operated reverse gear for marine installation, with reduction gears where required	
Accessories	Governor Electric or air starting motor Coolant circulating pump Sea water pump for marine engines Fuel filter Air cleaner	

Equipment List

Aluminum Castings	Aluminum Co. of America and Bohn Aluminum Co.
Bearings	Allison Div., G.M.C.
Connecting Rods	Packard Motor Car Co.
Controls	
Propulsion Engines	Westinghouse Air Brake
Crankshafts	
Forged	Wyman Gordon Co.
Machining	Muskegon Motor Co.
Specialties	Packard Motor Car Co.
Filters	
Air	Air-Maze Corp.
Fuel	Fram Corp. and Purolator Products, Inc.
Lube	Fram Corp. and Purolator Products, Inc.
Fuel Injection	American Bosch Corp.
Governors	
Speed Regulation	Woodward Governor Co.
Overspeed	Packard Motor Car Co.
Heat Exchangers	
Intake Air	Harrison Radiator Div., G.M.C.
Lube	Harrison Radiator Div., G.M.C.
Water	Ross Heater & Mfg. Co.
Pistons	Aluminum Co. of America
Rings	American Hammered
Pumps	Sherwood Brass Co.
Starting Motors	Leece-Neville
Starting Capsuls	Standard Oil Co. (California)
Vibration Damper	Houde Engineering Div., Houdaille-Hershey Corp.

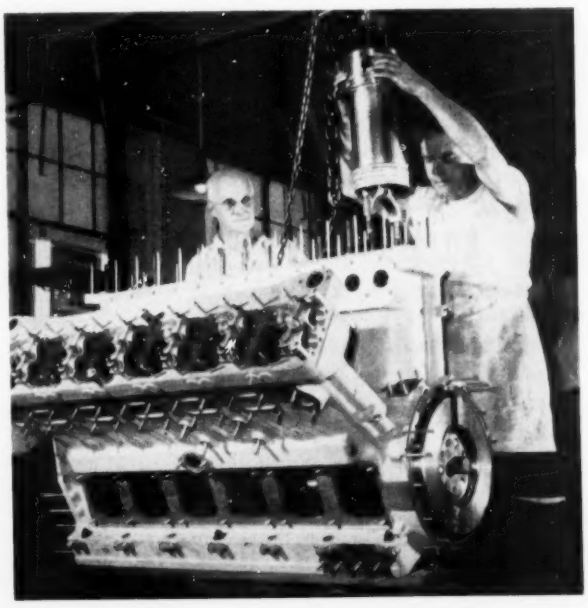
Here, a completely assembled unit consisting of integral head and liner with valves, piston, and connecting rod is being inserted into the cylinder block.

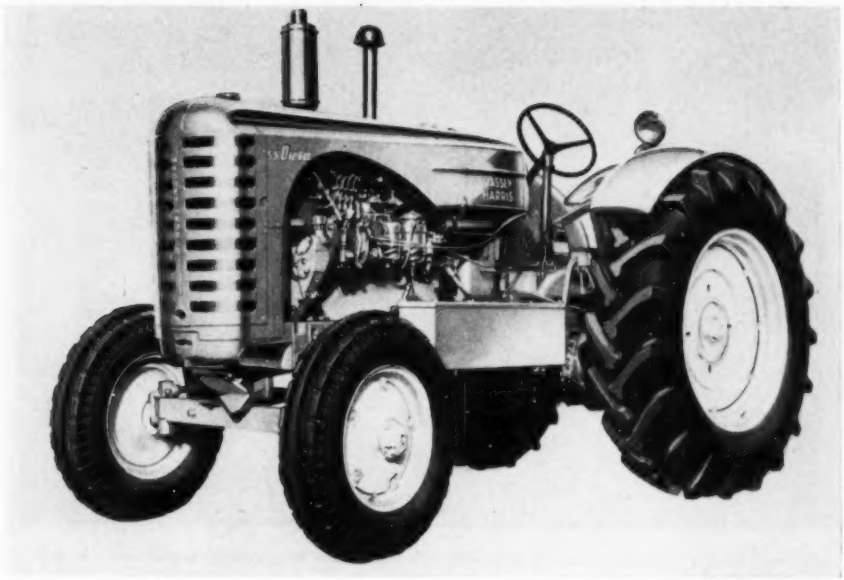


The following table illustrates the power-to-weight ratio comparatively, between the Packard series 142 diesel engine and other well known makes.

Comparison Specific Weight (lb/bhp)

Make	Bhp. (continuous rating)	No. Cyl.	Shipping Weight— (lb.)	Lb./bhp
Packard	300	6	2200	7.34
Packard	600	V-12	3250	5.41
A	520	24	12,600	24.23
B	348	6	13,000	37.35
C	374	V-12	14,000	37.43
D	345	V- 8	4,800 (industrial)	13.62
E	350	V-12	5,700	16.28
F	335	6	12,000	35.82
G	185	6	4,600	24.86
H	152	6	4,310	28.35





Another of the various types and makes of diesel powered farm tractors is the Massey-Harris model 55. It is capable of pulling four or five 14 in. plows

Farming With Diesels

A diesel powered tractor offers many advantages on farms today. Its operating characteristics and high degree of dependability make it a much desired type of tractor.

THE use of diesel power in various types of farm equipment is by no means an oddity today. In recent years, farm tractors in ever increasing numbers have been powered by diesel engines. With the present economic situation such as to encourage an even greater use of farm machinery, the challenge of meeting the farmers' need for more efficient machinery rests with the industry.

In an answer to this challenge, many manufacturers of farm tractors have added the diesel with its greater economy and dependability. The compactness of more recently developed diesels with greater power-to-weight ratio affords a trim installation. In addition, reserve power is available which helps to eliminate shifting and stalling on most grades and hard-to-plow spots.

Another important factor is that a diesel uses only the amount of fuel needed to do a given amount of work. This is in comparison to gasoline engines which require a definite fuel-air mixture in order to prevent missing or stalling.

Thus, a large diesel tractor may be used economically for both large and small farm operations. In many instances, this does away with the necessity of owning a smaller tractor and eliminates the costs of maintenance and housing of the second machine.

Now, let's take a look at one of the modern diesel powered farm tractors. For example, we will take the Massey-Harris tractor. The diesels used in these tractors are of the 4-cyl, overhead valve design with full pressure lubrication, removable cylinder sleeves, and full-length water jackets.

The high efficiency power output and low fuel consumption of the Massey-Harris diesel design is attributed to a special energy cell. This cell, called the "Dyna-cell" is located directly across from the fuel injector and receives the bulk of the fuel charge. Firing is cushioned by the metering action of the cell. At the same time a powerful rotary action is started which provides better turbulence.

There are two sizes of diesel engines used in these tractors. The smaller of the two is the model 44 diesel. This engine has a 260 cu in displacement which provides adequate power to pull 3 or 4, 14 in plows.

The larger engine powers the model 55 diesel tractor and has a 4 to 5 plow capacity. This model is a 382 cu in engine. Both the model 44 and 55 engines operate at 1350 rpm.

In addition to Massey-Harris, a number of other farm tractor manufacturers are producing diesel powered farm tractors. With a diesel in his tractor, the American farmer can cut his operating time and costs almost in half. Recently, farmers throughout the country have turned in almost unbelievable reports on the performance of diesels in wheel-type farm tractors.

The increased use of tractor power and associated farm machinery is an important factor in the struggle to feed an ever-growing population. Proper use of tractors and modern farm equipment can expand production through better tillage.

Here is where the diesel's higher operating speed and reserve power will aid the American farmer, enabling to, as the saying goes, "make hay while the sun shines."

Above, an engine is being removed from a diesel-electric locomotive unit. Replacement is quickly made with another engine and the unit returned to service.

At this point, engines are completely assembled, printed, and stored until needed for replacement as in the first illustration.

Converting Heavy Locomotive Repair Shops—Steam to Diesel

By Fay Thomas*

Considerations of the many factors involved in setting up diesel locomotive heavy repair operations in a converted back shop have been clearly outlined in a paper—here condensed—presented before the New England Railroad Club.

WHEN diesel locomotives were first being installed in the railway system, it was not easy to foresee that this type of power would in a relatively short space of time emerge from a novelty, to take the leading role in motive power on American railroads. So rapidly has the trend been toward diesel-electric motive operation, that the railroads have been unable to keep pace in providing adequate maintenance facilities.

**Assistant to General Superintendent Equipment, New York Central System*

Constant increase in number and type from various builders, unnecessarily resulted in high maintenance costs and lowered availability. Many makeshift arrangements were instituted to do running repairs and make heavy overhauls in the same location.

While individual circumstances must rule in arriving at a decision as to proper facilities, there are a number of factors which apply to all. The locomotive unit parts must eventually receive the same kind of repair, whether the unit is one of a few, or one of many, owned by one road.

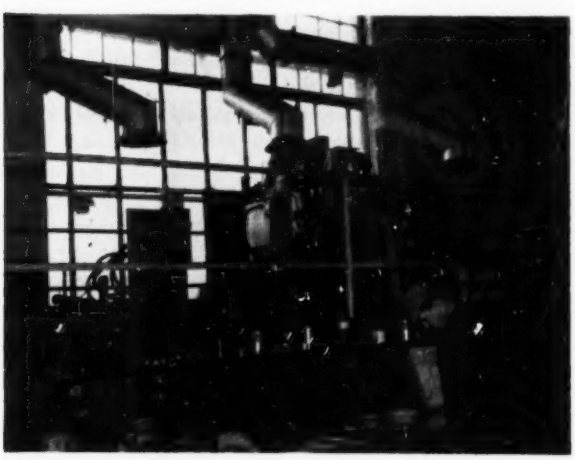
Planning Important

Two types of diesel locomotive shops are required, the running repair shop and the heavy repair shop. Of the two, the simplest is the running repair shop. Work done here includes the inspection, cleaning, and replacement of unit parts on the locomotive. For entire dismantling of the locomotive, the heavy repair shop is needed. Here parts are reconditioned or renewed, and the unit rebuilt. This type of shop should employ production methods as far as possible.

To realize returns to the fullest extent on the heavy investment in diesel locomotives, highest availability and lowest cost of maintenance and repairs along with high quality of workmanship are essential. The New York Central System has a complete plan worked out, establishing running repair and heavy repair shops. This general outline of conversion is based largely on the changeover of the Collinwood steam locomotive heavy repair shop at Cleveland, Ohio.

Selecting a Shop for Conversion

Considerable thought should be given to the selection of a shop for conversion. A central location is required, since this shop will have to furnish reconditioned parts and assemblies to the running repair shops. The manpower situation in the proposed shop area must also be investigated. The best laid-out shop cannot function properly if personnel is not available or if there is constant turnover.



Steam generating units are rebuilt and tested under simulated operating conditions. The test stand is designed to accommodate three generators simultaneously.

The selected shop should have rectangular buildings, since this type is the most easily convertible. Most back shops have buildings with a number of stalls, pits, and heavy crane facilities, which are suitable for stripping and assembly operations. A study should be made of these, checking length of stalls and clearances for shop traffic around units.

Crane hook clearances should be determined. A 33-ft clearance is adequate for lifting oil engines from units. However, if existing structures prohibit this ideal height, it is possible to get along with less clearance by developing special lifting devices. Study crane capacities. A 30-ton crane can handle the heaviest parts in any locomotive. In some instances, cranes of 100- to 200-ton capacities are available. This is a distinct advantage, as cranes of these capacities will lift an entire locomotive unit.

Having decided on the number of units to be repaired monthly, a careful survey is necessary to make certain that the space available is sufficient for the assignment. Provisions for emergency repairs should also be considered.

Organizational Set-up

A personnel organizational line-up for a shop, having a total force of approximately 2000 men with capacity to outshop from 60 to 70 units per month, should be developed.

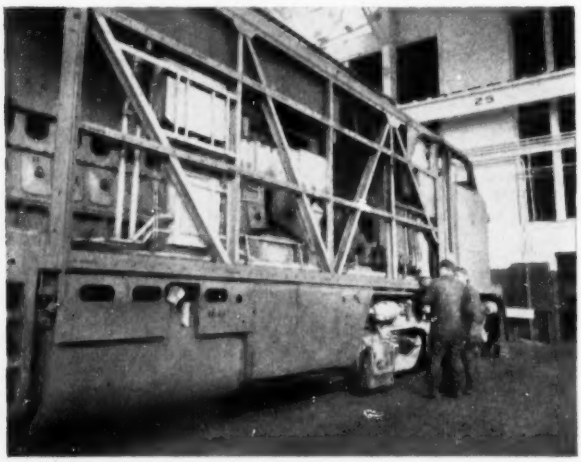
A shop manager, or an official of equivalent capacity, heads this line-up. His office coordinates the scheduling of the shop work with the requirements of the entire railroad. The general office force and experimental department are directly under his supervision. The shop superintendent is second in line. He has on his staff, the general foreman in charge of shop operations, the plant engineer, the apprentice instructor, and the power plant force.

The general foreman ranks next. He has four assistants, each in charge of one of the four main divisions of shop. These are listed as erecting, truck, electrical, and machine shops. The production supervisor and the supervisor of shop orders, report directly to the general foreman, who also has charge of a portion of the labor force. This group of laborers and truckers can readily be assigned to the various divisions, as shop traffic or other needs warrant.

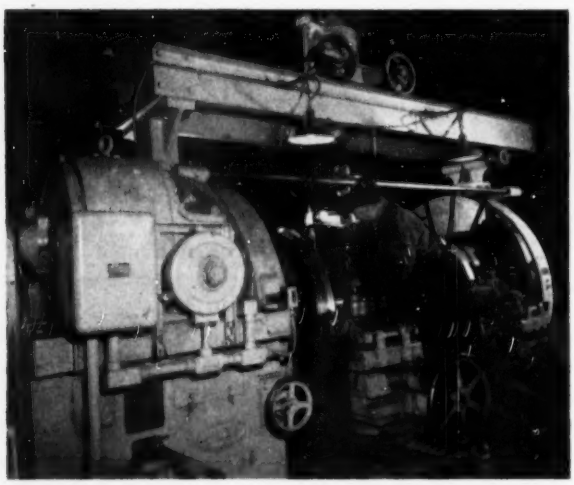
A typical breakdown of the four main shop divisions is as follows, with an assistant general foreman in charge of each:

1. The erecting division foreman is in charge of all stripping as well as erecting operations. His total force for three trick operations, runs to about 600 men. This includes 504 craftsmen, supervised by 15 foremen and 9 assistant foremen. An additional 72 laborers, supervised by three assistant foremen are included. (This labor force is separate from that directly under the general foreman.)

The traction motor shop handles the repair of main generators, auxiliary motors and traction motors. Here a commutator on a traction motor armature is being turned down.



Units are inspected as dismantling proceeds in order to find hidden defects. In many cases initial inspections do not find all defects.



Large wheel lathes true both wheel flanges simultaneously. Operator checks flange contour with a special gauge.

2. In addition to the truck shop, which is the main responsibility of the truck division foreman, he has supervision of the paint, wheel, air brake repairs, pipe, welding, blacksmith and fabricating shops. In general, each of these shops will have one foreman per trick, with assistants as necessary; but not all will be working three tricks. A separate labor force of 52 men, supervised by an assistant labor foreman for each trick, is also assigned to this division. The total for this department will be about 500 men, when operating under full production schedule.

3. The electrical equipment division foreman's responsibilities are divided three ways: (a) the traction motor shop, which has a force of approximately 300 men, supervised by three foremen and nine assistant foremen; (b) the electric shop, handling wiring, contactors, control equipment, and associated parts, which has a force of 70 craftsmen, supervised by a foreman for each trick; and (c) the battery shop, which is operated by 30 men supervised by a foreman and one assistant foreman. This brings the total electrical force to 400 men.

4. The machine shop division foreman is responsible for small parts repair, injector and governor room, engine overhaul, and steam generator reconditioning, as well as machine shop proper. The total force in this division is about 400 men.

Entire manpower requirements are based on a full production schedule, having one, two, or three tricks as necessary. Assignments average about 20 men per supervisor. Excluding possible delays from material shortages or for other reasons outside the control of the shop forces, the overhaul of an average unit should be accomplished in about 5900 manhours.

Plan of Shop Operation

Before details of shop procedures are considered, a few matters essential to successful operation of the entire shop are worthy of elaboration.

It is of utmost importance that a well-organized and well-equipped material department be set up. A system of coordination between shop and storeroom is a must. Success or failure of any shop depends upon the ability of the stores department to supply material and parts when needed. It must be a central point for furnishing materials to running repair shops over the entire system.

A study should be made of machine tool equipment available in existing shops selected for conversion. It is possible to utilize standard lathes, drill presses, and similar equipment. However, experience has shown that the larger machines do not lend themselves to efficient use in a diesel production-reconditioning shop.

A well-coordinated tool system is of utmost importance. In order that workmen stay on assigned jobs and do not have to waste time walking long distances for tools and supplies, a number of highly skilled craftsmen are needed to maintain all tools in perfect condition.

Sturdy portable platforms for use in the erecting shop, at both ends and sides of units, should be provided. These permit performance of work inside the engineroom, on the floor level, and outside the locomotive and cab sections. Other elevated or depressed floor levels, pits, and other devices, will make it unnecessary for men to consume energy and time, working in tiresome and inefficient positions.

Careful consideration is advisable of such items as containers for handling parts, various types of transports, and routing of parts through the shop. If a large amount of engine frame and truck frame repairs are expected, a stress-relieving furnace of adequate size will be advantageous.

Dismantling the Locomotive

The dismantling operation is preceded by a short interior cleaning before the unit enters the stripping area. The stipping section, while part of the erecting shop division, is nevertheless separated from the assembly line. As a result, the assembly line will be cleaner and there will be less chance for tools and parts to become mixed.

Actual dismantaling of the locomotive begins with removal of roof hatches, the disconnection of ducts, and the lifting of the oil engine out of unit, after it has been uncoupled from the air compressor and auxiliaries.

As dismantling proceeds, the component parts of the locomotive are directed to their respective repair departments. Each of these departments has specialized subsections for certain operations. These sub-sections accomplish the required degree of perfection, by specialization. Necessary operations are achieved to remove the trucks from under the unit and place dummy trucks or pedestals under the car body.

Erecting Shop Division

The operation of a production shop can best be described by following the progress of an oil engine, after removal from its unit.

Disassembly station No. 1 receives the engine on dollies operating on a narrow track. On each side of the engine, there is a platform not less than 30 in wide, 15 ft long, and 37 in above the floor level. These platforms and all similar succeeding ones should have air and electrical connections built into them. Work on this station includes tear-down at both ends, removing gear trains, blowers, oil and water pumps, etc. All of these parts are placed in containers for movement to automatic cleaning machines.

Station No. 2 has similar platforms, but the floor underneath them, is depressed for proper headroom and to allow for an efficient working position. Light crane facilities are provided above the platforms. Parts removed here, include pipes, heads, pistons, liners, and crab nuts. Again, all parts are forwarded to cleaning machines. Head and liner pullers, impact wrenches, and all special tools are located in the best positions and are the responsibility of the men assigned here.

Station No. 3 has no stationary platforms or pits, but an engine-turning device is installed at both ends. A portable platform may be used in removing the crankshaft. At this point, the engine dismantling is completed.

Repair Section

The engine frame is removed, by an overhead crane, to the automatic cleaning machine, located near the disassembly section. Here the frame is agitated in a cleaning agent until all foreign material is gone, and then is rinsed and dried. Magnaflux examination is next. At the same time, a check for crankshaft main bearing alignment is made, by an optical method employing a telescope. After the frame has passed inspection, it is given a coat of paint and is ready to go to the reassembly section.

Small parts, after being cleaned, are sent to their special repair sections where they are inspected, magnafluxed, checked for wear limits, and reconditioned. Cylinder heads are given hydrostatic tests, and if repairable defects are found, they are sent to the welding shop. Cylinder liners, pistons, connecting rods, etc., are sent to their specialized sub-sections for examination and reconditioning. Parts requiring special precision work are sent to a dust-proof room which is equipped with special testing, maintenance, and precision calibration apparatus. The crankshafts are dynamically balanced and checked for size, then sent to reassembly station for installation in the engine frame.

Reassembling the Engine

The make-up center receives the reconditioned parts, and here is where the parts scheduling for the assembly line begins. Any overflow of reconditioned parts is sent off to the stores department for shipment, as needed, to other sections of the railroad.

The assembly section consists of platforms and pits similar to the disassembly section. The number of assembly stations, with crane facilities, varies from four to six as the type of engine being assembled calls for. The engine moves along on dollies from station to station. Since assembly work requires greater accuracy over disassembly, the number of stations are increased.

Test Room

After the reassembled engine enters the check room and receives the final approval from the inspector, it is picked up by an overhead crane and sent to the test room. The test room should have adequate facilities for operating three engines and main generator at the same time. The test stands should be equipped with "T" slotted base plates and movable parallels so as to accommodate different types of engines.

In the test room, all instruments for exhaust, water-cooling, and lubricating systems should be provided. The exhaust equipment should include inside pipes, in a fixed position, running the length of the test stand to accommodate all makes of engines. Flexible pipes with adapters should connect engine exhaust to fixed exhaust pipes. Inside exhaust pipes should be supported by upright beams, one of which carries a jib crane for handling various ex-

haust adapters. Outside silencers extending above roof level should also be provided.

The cooling system for the test stand should be the closed type, with individual radiator sections of adequate capacity to handle the largest engines. If it is arranged with a by-pass system, any section may be used for any stand. A minimum cooling capacity of 300 gpm should be provided. Each section should be supplied from one main storage tank, equipped with a water treating system.

As for the lubricating system, it should consist of storage tanks, pumps, filters, and other equipment used on the largest engines and be provided with a preheating arrangement for storage tanks. If a large storage tank is found to be necessary, it may be housed outside the test room, in a structure containing the water cooling system.

The engine is now ready for installation in a locomotive unit. Or it may be shipped to a maintenance shop as a replacement.

Truck Overhaul

Truck reconditioning is performed by production shop methods too. Disassembly work is done on two parallel lines to permit greater flexibility.

The first station on each line has a 52-in deep pit, with the outside floor level 17 in below the top of the rail. The traction motor and wheel assembly units are removed here. After removal of the suspension bearing caps, the wheel and axle assembly with the journal bearings are sent to the wheel shop. The traction motors go to their respective shop. All easily accessible parts, such as brake cylinders and riggings are then removed and sent to cleaning vats, and from there to the repair stations. The truck frame is then turned over and set on dollies.

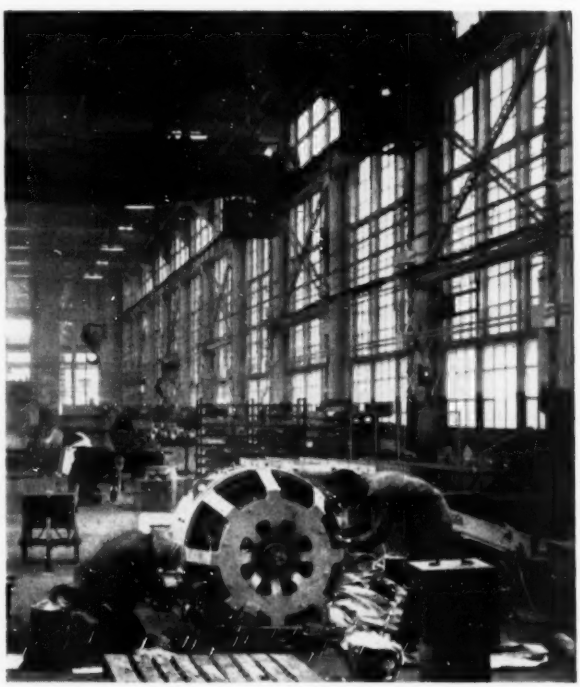
At the next station, the truck disassembly is completed and the truck frame remains on dollies for movement to the lye vat. The dollies should be so constructed as to permit the use of them as carriers when the frame is submerged in the lye vat. The lye vat treatment is sufficient for cleaning in most cases, but in some instances sandblasting is necessary.

After cleaning, the frame is sent to the magnaflux station for inspection, and thereafter undergoes any necessary repairs. The assembly line receives the reconditioned truck frame on dollies in an inverted position. Reconditioned parts are supplied to it and the rebuilt traction motor and wheel and axle assemblies are installed.

Traction Motor Shop

The traction motor shop should be housed in a building adaptable to production line repairs of traction motors, main generators, and auxiliary motors. On many railroads, this class of work is increasing considerably as additional diesel locomotives are received and are in service long enough to need heavy repairs. The capacity of this shop may be supplemental to, or combined with, the electric shops already set up in most railroads for similar work. But capital outlay for such a shop is rather high since a great deal of specialized machinery is necessary to reach a favorable production figure.

Design details of this shop necessitate a number of considerations: Information covering types of equipment and number of pieces of each to be overhauled must be available; The shop must be able to perform work on traction motors and generators for the entire railroad; Good lighting, precision machinery, adequate crane and truck and car loading facilities must be available; Allowance of space for expansion as volume of work increases, must be arranged; Straight line assembly method of work should be synchronized to allow motor repair to start at one end and the finished product to leave at the other end of the shop; The traction motor stripping section should be located close to the delivery point, but separated by a wall to keep the production line orderly; Adequate material stock should be located near the point of application; A dust proof room for bearing inspection should be provided; Operation must be broken down into small phases so that one man can be easily trained to perform a single phase satisfactorily; Special attention must be paid to protecting the traction motors and generators against damage in shipping from other points on the system.



Large rectangular buildings should be used if work is to be done on a production line basis. High capacity overhead cranes aid in moving heavy parts to various assembly or disassembly points.

Auxiliaries and Miscellaneous Parts

While work progresses on principal assemblies and parts previously mentioned, there are many additional parts which must be handled. Accessory equipment such as traction motor blowers, cooling fans, load regulators, cab heaters, and air brake equipment are reconditioned in the proper repair sections. Wiring, piping and other equipment receive special inspection. As far as possible repairs are made without removal from the car body. If possible, cable runs should be made up in the electric shop, by use of standard template boards.

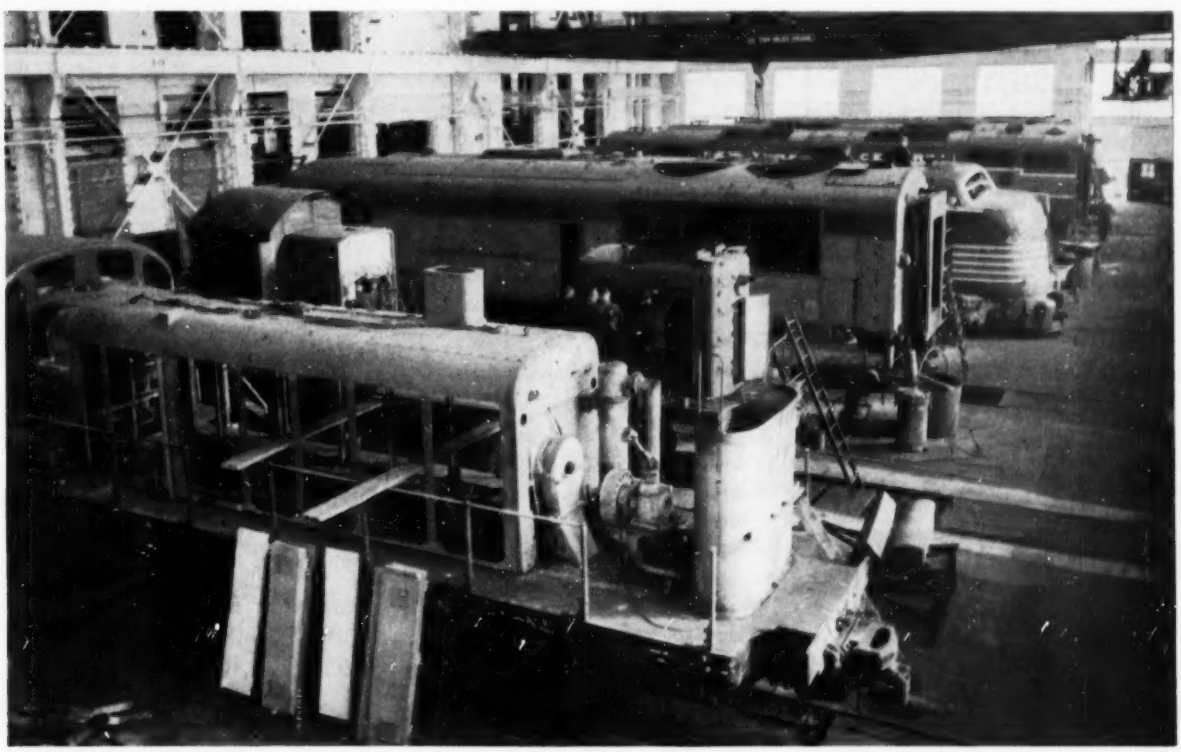
Any car body parts or body attachments found defective during stripping or inspection, are repaired in place or sent to the fabricating department. This shop repairs the old piece or makes a new one. All other necessary work, inside or outside the cab, is done at the same time.

The steam generator, important in passenger service, is lifted through the roof hatch during stripping operations and sent to its reconditioning section. Here it is dismantled, cleaned, inspected and placed in line for rebuilding.

Work benches are set up in a production line for specialized testing and assembling. Test benches are arranged so that all controls, pumps, gauges, and other equipment can be pretested and set, under normal working conditions, prior to application. Coils are sand-blasted, acid-washed, and tested by application of 1200 psi hydrostatic pressure. If found serviceable they are mounted in the casing, sealed, and made ready for reapplication of all auxiliary parts and controls.

The generator is then placed upon a specially built test stand where all conditions experienced in service can be duplicated under a full eight-hour load test. After being painted, the generator is ready for application to a unit or shipment to a maintenance point. Special cars with roof opening hatches have been developed to permit quick handling over the system, in express service, for these units.

A completely reassembled locomotive unit undergoes an eight-hour shakedown test when all final adjustments are completed. The unit is then sent to a paint shop for interior finishes, exterior standard colors, lettering, and numbering. Final inspection is then made to see that all prescribed ICC records and other instructions and equipment are installed in the proper locations. The completed unit is then outshopped and sent to ready track to be placed in service. In the case of switching units, it is forwarded dead in train to the designated point of assignment.



Units with engines removed are placed on dummy trucks in separate stalls where further maintenance and repairs are completed. While the work here proceeds other parts are undergoing repairs in their respective shops.

DIESEL BRIEFS

Old Timer

After 18 years of service, this diesel is still going strong. Originally, it was built for truck duty in 1934. It is a model HA-400 Cummins diesel and until 1938, powered a model AB Mack. At this time it was traded for a new Cummins engine. The engine was then rebuilt and adapted for industrial duty. During the same year, the engine was installed at the St. Cloud Monument Company, St. Cloud, Minnesota, driving a 10 by 10 air compressor. Since that time the engine has operated eight hours a day, five days a week.

This is only one of many instances where diesels have been in service for a number of years. A good example of the benefits to be derived from proper preventive maintenance and operation.

New Diesel-Electric Rail Car Introduced on New Haven

A new diesel-electric rail car, known as the Mack FCD rail bus, which may solve the problem of handling light branchline service economically for many railroads, has made its debut on the New York, New Haven and Hartford Railroad.

Designed and built by the Mack Manufacturing Corporation and equipped by General Electric, the car operates on a 17-mile stretch between Mansfield and Fall River, Mass. The car is an adaptation of the 50-passenger Mack bus. Its power plant is a Mack 220 hp supercharged diesel engine directly connected to a GE generator which drives four 55 hp traction motors.

The chassis is mounted on two four-wheel PCC car trucks with one motor driving each of the four axles. Coil and rubber springing in the truck suspension, resilient steel wheels, hypoid motor gearing, provide smooth and quiet riding.

The car offers passenger service where none has been provided for in the past 20 years. New Haven officials believe the operating cost will be one-fourth that of present equipment.

Rock Island Adds Diesels

The Rock Island Lines announced that it has taken delivery of four new diesel electric locomotives in July and nine in August.

In the first seven months of the year, the railway received 29 new locomotives, varying in size from 800-hp yard switchers to 2250 hp passenger diesels.

An additional 16 switch engines are scheduled for delivery this month and October. The Rock Island hopes to be dieselized on all but two divisions by the end of this, its centennial year.

$3500 for Suggestion

Two employees at the refinery of Socony-Vacuum Oil Company in Paulsboro, New Jersey, were jointly awarded $3500 under the company's suggestion system. The award is the largest ever made by the company for a single suggestion.

The suggestion, submitted separately by each of the two award winners, brought about a reduction in shutdown time and in loss of solvent used in the refinery's duo sol unit, which processes high-grade lubricating oils.

Westinghouse Fellowship Fund

A fellowship fund to help promising young engineers and scientists of the Westinghouse Electric Corporation continue their studies on a graduate level has been established. To be eligible for a fellowship, a candidate must have shown marked ability in engineering or scientific fields and must be an employee of at least two year's standing.

Caterpillar Expands

The Caterpillar Tractor Co. manufacturer of diesel tractors, marine engines and road machinery is having the Luria Engineering Company erect two new steel buildings at Joliet, Ill. The structures will add 32,000 ft to plant facilities. Completion is scheduled for this month.

DIESEL BRIEFS

Reduce Costs For Rebuilding Diesel Locomotive Components

United States railways have been given notice of major reductions in labor charges upon rebuilding of principal components of diesel locomotives in the network of six factory rebuild plants of the Electro-Motive division of General Motors.

The labor charge upon strip and rewind of traction motor armatures was reduced 30 per cent and other labor charges 10 per cent. The traction motor rewind job constitutes the largest single item in the business of the factory branches.

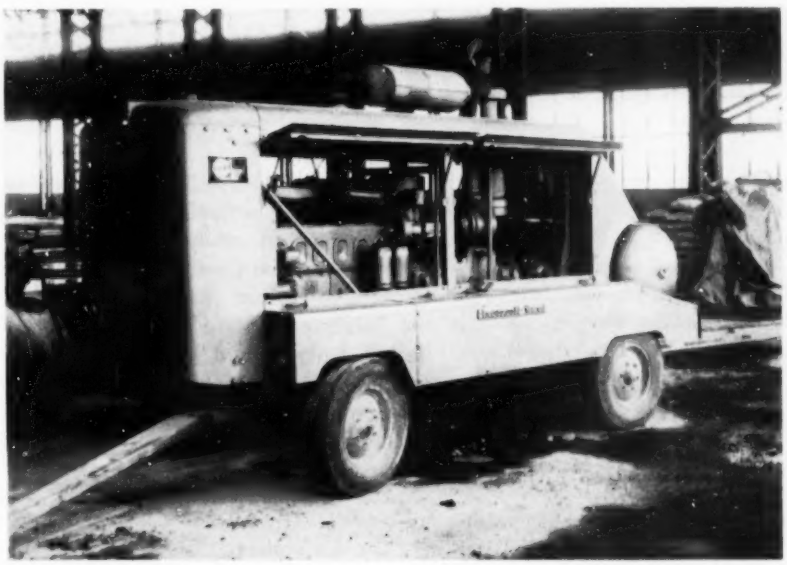
Pollution Control Project

A $6,000,000 Rockaway Pollution Control Project has just been put into operation. It is the last of four needed in this section of New York City to reclaim the 12,000 acre Jamaica Bay area for development as a wild life sanctuary and for swimming, fishing and boating. This is one of seven plants that make up the $107,000,000 first stage of the city's pollution control program.

$30,000 Design Award

A new competition for designers, engineers, and manufacturers of machinery of all types has just been announced by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. The new $30,000 mechanical design award program offers 101 cash awards, as well as national recognition for the best papers describing the mechanical design and construction of any type of machine or machine component which is designed for arc welded steel fabrication.

Eighteen different classifications are given in this program to stimulate the scientific advance of machine design through the wider use of arc welded construction. The program closes July 27, 1953. Rules and further details are available from the Lincoln Foundation, Cleveland 17, Ohio.



Rotary Air Compressor

The speed with which pneumatically applied concrete walls can be constructed has been increased approximately 25 per cent. The increase is due to the use of a recently developed 600 cfm rotary air compressor in place of the conventional type 500 cfm compressor.

The rotary compressor, the "Gyro-Flow 600" was developed and manufactured by Ingersoll-Rand. It is powered by a 6-cyl GM engine turning at 1800 rpm, which is direct-connected to the compressor. The availability of compact high speed diesels was an important factor in the development of this new compressor. The smaller high speed diesels have helped the designers produce a compressor of higher capacity and also reduce its size and weight in comparison to portable units of equal output.

Pakistan Orders GM Diesel Locomotives

General Motors has received an order for 40 diesel locomotives from Pakistan. They are for service on the meter gauge lines of East Pakistan, often known as the Eastern Bengal Railway, and will be the first diesel electric locomotives to operate in East Pakistan.

The road locomotives are designed for universal freight and passenger service suitable for the light axle load requirements of meter gauge railway conditions, with AIA-AIA wheel arrangements. All will be powered by the GM model 567 diesel engine.

Internal Combustion Engines Congress To Be In Milan

A partial congress of the International Internal Engines Congress will be held in Milan in April 1953, it was announced. The subject for discussion will be, "The Use of Heavy Liquid Fuels in High and Medium Power Diesel Engines".

The first congress was held in Paris last year, on the initiative of the French syndicate of internal combustion engine constructors. Austria, India, Norway, Spain, and the USA participated. The results are recorded in two volumes of proceedings of more than 800 pages each.

Shaft Currents in Engine Driven Generators

*by A. H. Lauder**
General Electric Co.

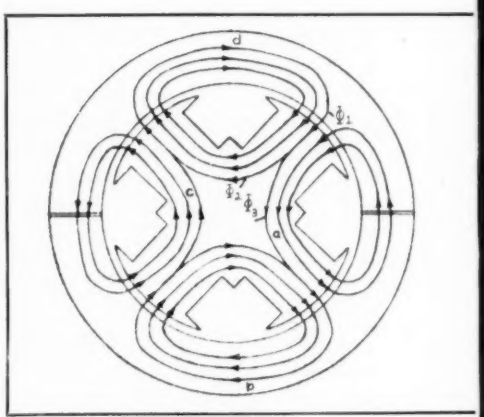
Back in February, 1950, we first ran this article. It was thought to be an excellent explanation and corrective procedure for an electrical phenomenon that occasionally arises to plague the engine operator.

Interest at the time was high and the material was reprinted and widely quoted. In February, 1952, we made reference to it in our "Straight from the Toolbox" feature in connection with an item wherein the operator had licked the problem by a "grounding device". More requests were received for this article, cleaning out our supply. In view of this interest it was decided to reprint the article as a service to our readers.—Ed.

Avoiding detrimental shaft currents in rotating electrical machines undoubtedly dates back to the days when large multi-polar generators were first produced. A list of frequently quoted references indicates a fairly comprehensive literature on the subject extending over a period of more than forty years.

Causes of such currents, the methods of minimizing them, and means of preventing damage to associated bearings, are well understood by the manufacturers of electrical equipment. Published information as to the levels of current that bearings will tolerate as compared to those ordinarily produced is rather meager, probably due to its limited interest. Emphasis has been placed on corrective measures which are relatively simple for the most destructive type of shaft currents. Sufficient investigation has been conducted, however, to establish the values of shaft voltage and currents which will define perfectly safe operation. This has been necessary in order to evaluate the probable effect of small shaft potentials that cannot be open circuited.

In spite of the fact that the causes of shaft currents are fully appreciated, the industry will continue to produce generators which require insulated bearings. The reasons for this are purely economic. A number of manufacturers insulate the bearings on machines above a certain size regardless of the presence of shaft current. This is a matter of good engineering practice. It is hoped that the justification of these statements will be evident from the material presented in the remainder of this article.



Scope

In developing recommendations on this subject considerations must be given to the causes of shaft currents, the types most prevalent in engine driven generators, and preventative measures. Information on the insulating of bearing pedestals and the identification of damage from shaft currents is included for the sake of completeness as it is felt that this will also be of interest.

Sources of Shaft Currents

The three principal causes of circulating current in the shafts and bearings of rotating electrical machines, together with recognized methods of correction are as follows:

1. *Alternating flux linking the shaft* —This is largely due to the relationship between the number of field poles and the number of lamination joints, dovetails, longitudinal air passages, or other permeance variations in the armature core. When one pole of a multi-polar machine is excited, the magnetic flux leaving that pole and crossing the air gap to the armature returns to the hypothetical starting point through all of the parallel magnetic circuits in the machine. The superposition of such flux patterns for

Representing the Large Apparatus Subsection, Motor and Generator Section, National Electrical Manufacturers Association. Abstract of a paper written for presentation at the Chief Engineers Meeting of the Diesel Engine Manufacturers Association, Chicago, Illinois, December 13, 1949.

all of the poles results in a simple distribution as indicated for a 4-pole machine in Fig. 1. Joints exist in the core at the horizontal center line. In this example, they are assumed to increase the reluctance of the core at the sides of the machine by 50 per cent. The flux density at the top and bottom of the core is 50 per cent greater than at the sides for the case of the rotor in the position shown in the figure. The field circuit has a low ratio of resistance to inductance and tends to maintain a constant flux through the poles irrespective of rotor position. With five units of air gap flux leaving and entering each pole as indicated, two units will link adjacent poles at the sides of the machine. Two of the three units at the top and bottom of the machine will have similar flow lines. The extra unit indicated as ϕ_1 will divide to maintain a symmetrical pattern of flux distribution in the rotor. Approximately one half unit ϕ_2 will return through an adjacent pole. The remaining half unit ϕ^3 will extend around a path a-b-c-d-a and link the shaft.

After the rotor has traveled ½-pole pitch, the center line of the poles will coincide with the split in the core. At that instant 2½ units of flux will flow in each of the four core sections and no flux will link the shaft due to the symmetry of both rotor and stator permeances. After and additional ½-pole hitch of rotation, the same configuration of flux will exist as shown by Fig. 1, except with opposite polarity. Hence, it is obvious that splitting the core of a 4-pole machine results in the shaft being linked by a flux which alternates with a frequency of two cycles per revolution. In general, any machine with a split stator having a number of poles divisible by a 4 will have voltages of line frequency induced in the shaft. Thus one-half of the total number of pole combinations will result in voltages and possibly shaft currents when split frames are used.

A generalization of the foregoing analysis has led to the following rules for determining the existence and frequency of shaft voltages:

a. *Equally spaced joints or permeance variations.*

Shaft voltage will exist if the ratio of twice the number of joints to the number of poles, reduced to its lowest terms, is an odd number or a fraction whose numerator is an odd number. The frequency of the voltage will equal to the product of the odd number and line frequency. If the ratio or numerator of the fraction is an even number, shaft voltage will not appear.

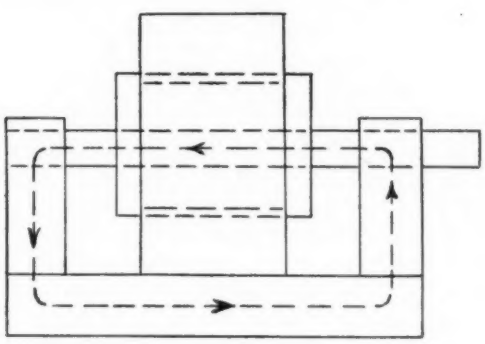
b. *Unequally spaced joints or permeance variations spaced in repetitive pattern.*

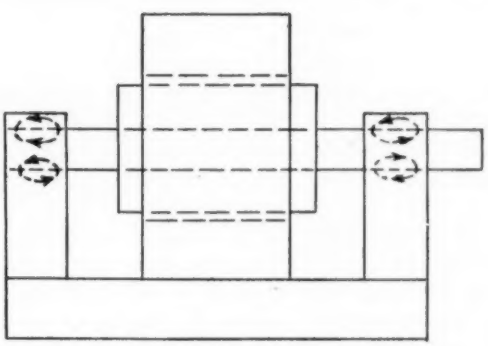
Shaft voltage will exist in the ratio of the number of joints to the number of poles reduced to its lowest terms is an odd number or a fraction whose numerator is an odd number. The frequency of the voltage will be the product of the odd number and line frequency. If the ratio or numerator of the fraction is an even number, shaft voltage will not appear.

Shaft currents, resulting from alternating flux linking the shaft, flow lengthwise along the shaft, across the oil films to the bearings, and return by way of the base as indicated in Fig. 2. Alternative return paths are piping, handrails, or conducting members of the foundation that may connect the bearings together. The magnitude of current flow depends on the induced voltage, finish or journals and bearings, and the condition of oil films.

The shaft voltage must be high enough to puncture the oil films or contact must be established through oil rings, deflectors, or surface irregularities in order for current to flow. It is for this reason that harmonic fields, variations in material and assembly tolerances have a minor influence in the production of shaft voltages. They may be responsible for the appearance of voltages along the shaft even with an ideal relationship between poles and permeance variations. However, these voltages are not sufficiently large in small and medium sized machines to result in troublesome shaft currents.

Shaft currents large enough to interfere with the operation of bearings can be prevented by using an ideal relationship between core joints and number of poles. Such a relationship can be attained with segmental punchings having symmetrically spaced dovetails in only about 1/3 of the to-

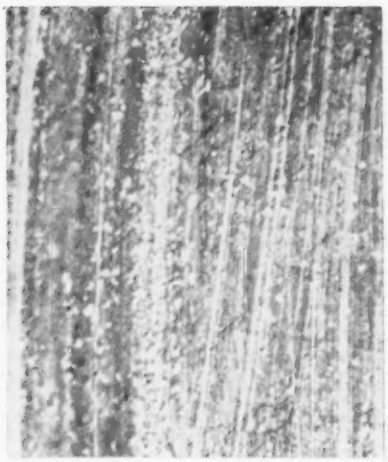




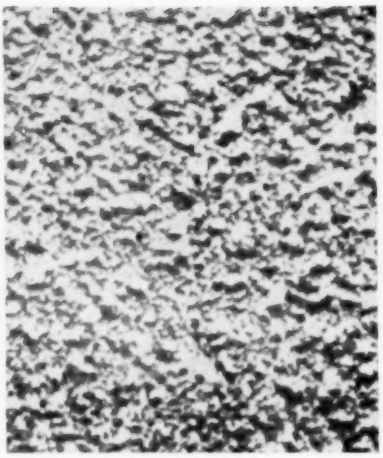
Left—Flux paths in a 4-pole machine with split stator.

Center — Circulating current due to shaft EMF.

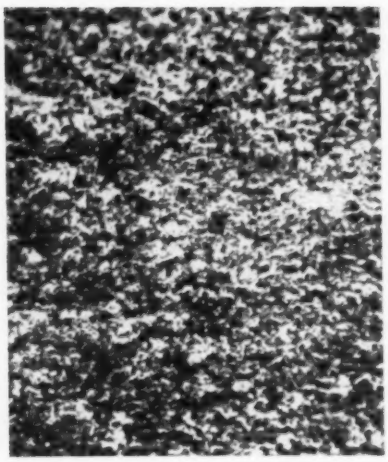
Right — Local currents due to shaft MMF.



Journal surface showing the characteristic speckling produced by shaft currents. (25X)



Complete erosion of original journal surface by shaft current magnification. (25X)



Babbitt surface completely frosted by shaft current. (10X)

tal combinations. Where such combinations are favorable they may not permit a satisfactory number of slots to fulfill other design considerations. And above all, the cost of tooling needed to attain such a relationship cannot be justified in all cases.

It is therefore necessary for every electrical manufacturer to produce machines which require protection from shaft currents. The most effective corrective measure for currents of the type previously described is to insulate one of the bearings or pedestals and thus open-circuit the shaft voltage. While the insulation is intact, no current can flow through the bearings.

Less effective protection can be obtained by shunting the bearings through metallized brushes and a low resistance connection. If the contact voltage drops associated with the brushes and shunt are lower than the breakdown value of the oil film, current will not flow through the bearing. If the reverse is true, current will divide between the bearing and shunt. Since this method allows shaft current to flow, all of the bearings along the shaft should be shunted for maximum protection. It becomes impractical where the number of bearings is large.

2. *Magnetization of Shaft*—The shaft of an electrical machine will become magnetized where windings, bus rings, or other connections are such that current encircles the shaft in one direction. Where equal currents flow around the shaft in opposite directions as is ordinarily the case, it will not become magnetized.

Where the shaft is magnetized and a complete circuit exists, the flux paths will be almost identical with the current paths shown by Fig. 2. Magnetic flux will pass from the shaft to the bearing housing and through the babbitt to the magnetic parts of the bearing. From there it will extend through the bearing pedestal to the base and return to the shaft through the remaining bearing. Voltages will be generated by homopolar action in that portion of the shaft where flux enters or leaves its surface. These voltages are in a direction to circulate current along the paths indicated in Fig. 3. Current flows along the journal, crosses the oil film at one end of the journal, flows back through the bearing and crosses the film at the opposite end of the journal. The magnitude of the voltages produced is dependent on the flux in the shaft and the velocity of the journals. The flux in the shaft is limited by saturation even in the case of steel bearings with thin linings. Consequently the shaft potential would be limited to a few hundred millivolts even with a saturated shaft, a condition not contemplated in actual practice.

Corrective measures consist of placing demagnetizing coils around the shaft or grounding the shaft to the bearing housing at each end of the journal through metalized brushes. Both procedures are sometimes used on homopolar type generators, particularly high frequency machines.

The detection of voltages along a magnetized shaft has led operators to suspect the presence of shaft currents. However, the number of cases where machines other than those of the homopolar type have given trouble is negligible. Direct current machines occasionally have a small amount of magnetism in their shafts. Conventional AC. generators are not so affected.

3. *Potential to Ground*—The existence of electrostatic potential to ground has been recognized as a possible source of shaft currents. An appreciable charge may exist on belts running over non-conducting pulleys where the insulation resistance is high. However, the leakage current to ground is usually at a lower rate than is the case with conducting pulleys. Experience has shown that such currents do not disturb the operation of bearings.

Insulation failures on grounded rotor circuits are apt to result in current flow through bearings. Due to the infrequency of bearing failures resulting from grounded windings, it is not customary to protect against potential to ground. Grounding the shaft through low resistance brushes would limit the flow of current through the bearings.

Identification of Damage from Shaft Currents

It is often difficult to determine the

basic reasons for bearing failures. In such cases bearing currents are sometimes suspected of causing the trouble. It is therefore important to have some familiarity with the appearance of parts damaged by shaft current. The accompanying illustrations were taken in connection with a series of controlled tests on apparatus constructed for the study of shaft currents.

Prior to damage by shaft currents, no particular effort was made to attain a smooth finish on these journals. The surface particles have an appearance similar to weld spatter. The appearance of babbitt surfaces under corresponding conditions is also shown.

When viewed without a glass the babbitted surface in particular has a frosted appearance with a texture similar to fine sandpaper. When the surface irregularities become sufficiently pronounced, interference may take place through the oil film and produce some dragging of the babbitt. Stopping and starting the unit will also drag the babbitt. If the bearing wipes and fails, most of the frosted area will disappear. One should therefore devote most of his attention to the journal when looking for signs of damage from shaft current. In the early stages, journal speckling is most apt to occur on the oil deflectors at the ends of the bearing or at the oil rings.

Fairly uniform marking along the journal indicates currents resulting from alternating flux linking the shaft. Marking which shows maximum density at the ends of the journal could result from a magnetized shaft.

Shaft Currents in Engine Driven Generators

Of the principal sources of shaft current, that due to alternating flux linking the shaft is by far the most prevalent and the only one where corrective measures are indicated on engine driven generators. The usual engine driven generator is a 3-phase alternator in which the circumferential current of the armature end connections is neutralized with balanced load. The single turn of field current surrounding the shaft produces very little shaft flux. Some magnetism may exist in the shafts of DC. generators driven by engines but the voltages ordinarily encountered will not be detrimental to bearing operation. Electrostatic potential to ground is not a probable source of trouble since only small units or exciters would be belt driven.

The conventional arrangement for a generator driven by a single engine is to mount the rotor on an extension shaft which is coupled to the engine shaft. The outboard end of the extension shaft is supported by a single bearing. Another variation is to couple a two-bearing generator shaft directly to the engine. In either case, shaft currents can be prevented from circulating by insulating the outboard bearing or bearing housing from ground. If the housing is insulated all metallic connections to it, such as piping, handrails, etc., must also be insulated.

Bearing insulation is most apt to be needed where generator bearings are on a common bed plate with the engine. A widely used arrangement is to mount the outboard bearing on a sole plate which is anchored directly to the concrete foundation. Concrete is an effective insulator and in order for a machine so mounted to be troublesome the following conditions must be fulfilled:

1. *The machine must be capable of producing shaft current.*
2. *The magnitude of the current must be large.*
3. *A solid unoxidized connection must exist between the foundation bolts for the generator bearing and those for the engine.*

Experience has shown that the probability of fulfilling all of these conditions is quite small.

A few electrical machines, particularly electric couplings, have their rotors overhung on the engine shafts. No bearing currents can flow with such a mounting, provided that the shaft is not magnetized.

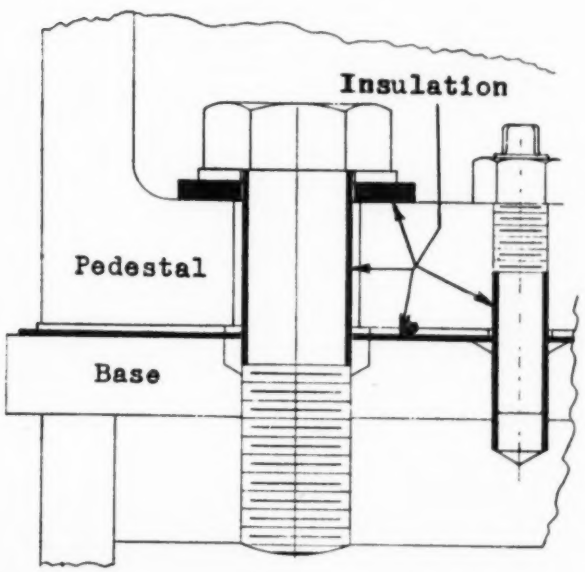
Interrupting the flow of shaft current in the case of a single generator coupled between two engines presents a more difficult problem. Assuming that the two engines cannot be isolated electrically (with the exception of the shaft connection) on a concrete foundation, one of the following means must be adopted:

1. *Ground the shaft on both sides of the generator through metalized brushes and thus divert part of the current that would otherwise flow through the bearings.*
2. *Insulate a coupling between the generator and one of the engines.*

Insulating the coupling, while completely effective, presents a problem in mechanical design and added expense.

Current Practice in the Industry

In all cases where bearings are



Method of insulating pedestal from base.

furnished as part of the electrical equipment, the electrical manufacturer furnishes insulated bearings where they are necessary. Inasmuch as incidental shaft currents, those resulting from variations in material or assembly tolerance, tend to increase in magnitude with the machine rating, some manufacturers insulate pedestal type bearings used on machines above a given rating. The minimum size is about 500 kva. Machines with bracket type bearings are insulated where necessary. Such bearings are applied mostly to small and medium high-speed machines. A comparatively small number of pole combinations are involved, which presents an opportunity to select an ideal relationship between core segments and poles in a majority of cases.

When generators are furnished without bearings, some manufacturers make no recommendations to the engine builder as regards the insulation of bearings. The outboard bearings are mounted on concrete in a majority of cases, including machines of large kva. rating. The experience of these builders indicates that actual cases of trouble from shaft currents are very rare. Other electrical manufacturers operate on the principle that a return path for the shaft currents may exist in every case and advise the engine manufacturer to insulate the outboard bearing when it is known that shaft current will exist. It sometimes happens that the presence of shaft current is not discovered until the final check is made prior to shipping the equipment. A recommendation to insulate the bearings at this time puts the engine manufacturer to considerable inconvenience.

Both of the above practices are of long standing. The latter of the two mentioned is, of course, the conservative practice, but has probably tended to over-emphasize the importance of the problem as far as engine driven generators and compressor motors are concerned.

Insulating Pedestal Type Bearings

A method of insulating a bearing pedestal from the machine base is shown in Fig. 4. The insulating shim is usually placed next to the base and the liners for adjusting the height of the pedestal are placed above the insulating shim. A 1/16-in. insulation is sufficient for the bolt, dowel, and shim. Cloth base phenolic laminate is recommended. NEMA classification LE is suitable for the bolt and classification C for the shim and dowel pin bushing. The latter should be pinned to the dowel and finished to size. Under the bolt head a ¼-in. hard vulcanized fibre washer placed under a steel washer has been found satisfactory.

In order to test the insulation after the bearing and shaft are assembled in the pedestal, it is necessary to raise the shaft out of the bearing. Care should be taken to eliminate all metallic contact between the shaft and pedestal. The insulation resistance of the pedestal to ground as read on a 500-volt insulation resistance meter should be in excess of 20,000 ohms. A lower value should be investigated as it may indicate mechanical damage to the insulation. If an insulation tester is not available the insulation may be placed in series with a lamp across an ungrounded lighting circuit. The slightest tendency of the lamp to glow is an indication of defective insulation.

As mentioned previously, all metallic connections to the insulated pedestal which are capable of providing a return circuit for shaft currents must also be insulated.

Do You Need Trained Diesel Men ?

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Conclusions

A consideration of the points brought out in this discussion leads to the following conclusions:

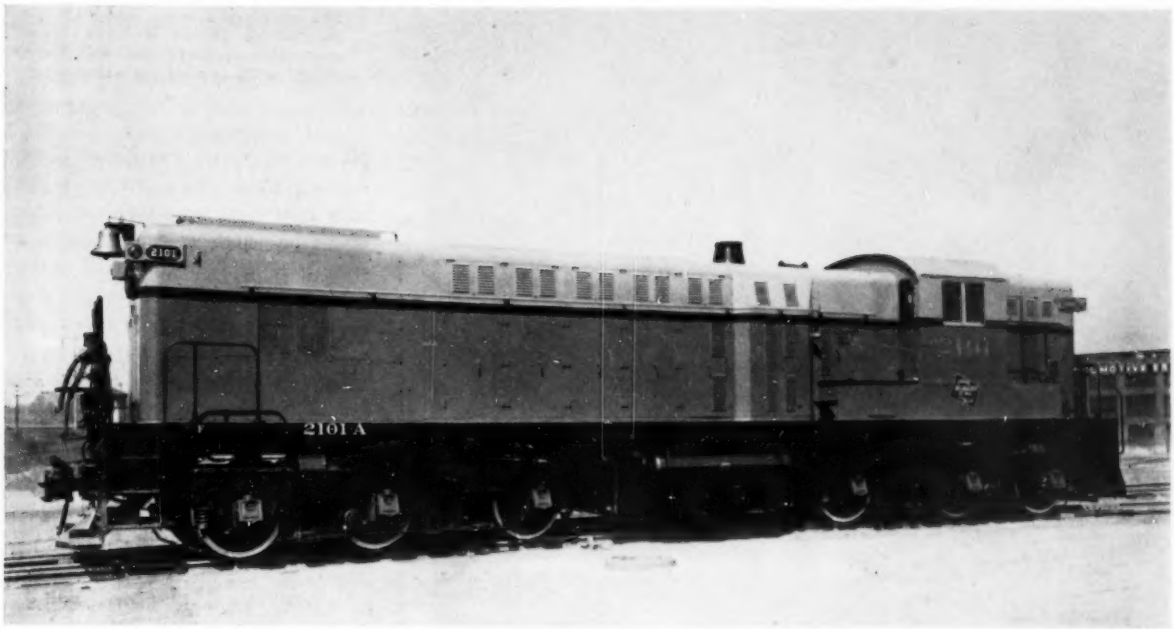
1. Manufacturers of rotating electrical apparatus have no intent of producing machines requiring protection from shaft currents where such can reasonably be avoided.

2. It is not economically possible to build engine driven generators free from shaft currents in all cases. In all probability this situation will continue since a majority of orders involve only one or two units with little repetition of design as regards speed, kva. rating, voltage, frequency, etc.

3. The only recommendations that the members of the Large Apparatus Subsection of the Motor and Generator Section of NEMA can make on this subject is one devoid of risk both to the Diesel Engine Manufacturers Association membership and the ultimate users of the electrical equipment.

This recommendation would be that the engine manufacturers provide insulation for their outboard bearings on all installations where the generator is driven by a single engine, and that they insulate a coupling between the generator and one engine where the generator is installed between and driven by two engines. A similar practice is followed by the electrical manufacturers in insulating bearings above a certain size regardless of necessity. The cost of insulating the bearings is small when included in the initial manufacturing planning. It avoids the disruption of schedules that occur when the installation must be provided after the machine has been completed.

4. Rather than accept the recommendation of Par. 3, the individual diesel engine manufacturers may wish to assume the calculated risk of furnishing insulation for their bearings only when they deem it necessary. This might take the form of insulating bearings mounted on a common bed plate with the engine in all cases, or when advised to do so by the electrical manufacturer, and omitting the insulation where the outboard bearing was placed on a separate sole plate set in concrete.



Two-Unit Switcher Has 3,200 Hp.

Ability of modern diesel-electric freight locomotives to pull longer and heavier trains is reflected in the size of switcher required in terminal operation. Here is an example.

by John E. Hubel

AT a cost of more than one-third of a million dollars—about $335,000—the Milwaukee Road has recently put a two-unit switcher into service. The locomotive went to work at Twin City Terminals, at Minneapolis and St. Paul, Minn. Built by Baldwin-Lima-Hamilton Corporation, this 116 feet of dieselized power is capable of developing a total of 3200 hp.

It consists of two units—a main engine and its auxiliary power unit. The diesel units were shipped to the Milwaukee Road shops in Milwaukee and were given a preliminary workout in that area prior to their shipment to the Twin Cities.

The two sections, when coupled together, are so long that it was necessary to uncouple them and run each section onto the 90-ft. turntable at the Milwaukee roundhouse. Each section of the diesels is 58 ft. in length. Each unit has six pairs of drivers, three pairs on each of the 3-axle trucks. There are three traction motors per truck.

The total weight complete is 652,400 lb.; tractive effort at starting at 25 per cent adhesion is 163,100 lb.; continuous tractive effort at 5.5 mph. is 166,000 lb. The gear ratio is 63:15. Fuel oil-carrying capacity for both units is 1900 gal.; lubricating oil, 200 gal.; cooling water, 300 gal.; sand, 30 cu. ft. There are two battery boxes per locomotive, each box having four 4-cell trays.

The engines develop their rated power of 1600 hp. at 526 rpm. at sea level rating. They are 8-cyl., Baldwin type 608-SC with a bore of 12¾ in. and a stroke of 15½ in. This power is used to turn a main generator, Westinghouse type 471, dc., interpole, self-ventilated, separately excited type, direct-connected to engine crankshaft. The free end of the generator is suspended in a self-aligning roiler bearing.

The auxiliary generator and exciter, Westinghouse type YG-42, is mounted on the main generator and driven by vee-belts. The generator provides for battery charging and the exciter provides power for excitation of the fields of the main generator.

The traction motors are Westinghouse type 370, 6-pole, series-wound, force-ventilated units driving the axle through single reduction gearing. Electro-pneumatic control equipment regulates generator power provided to the traction. Permanent series-parallel motor connections make transitions unnecessary. Unit switches and reverser are electro-pneumatically operated.

The engineman's controller is of the pneumatic throttle type, giving an infinite number of throttle positions. All of the description above applies to both the lead unit and the booster, except that the controls are provided on the lead unit only.

Each of the two units has an air compressor, with a minimum free air capacity of 70 cfm. at 315 rpm. and 192 cfm. at full rated engine speed of 625 rpm. They supply the air requirements of the air brake system.

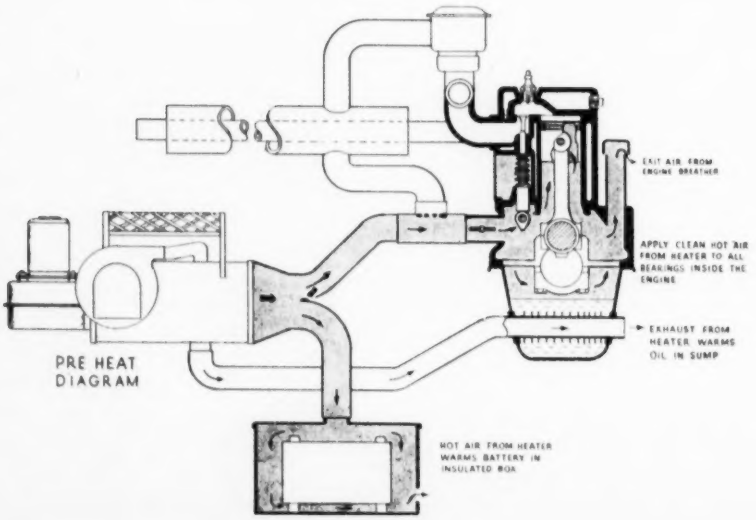
This small high-capacity heater can be mounted on engines in trucks, buses, construction equipment and various machinery which requires preheating.

IN recent years, considerably more thought has been given to the problems related to the starting of diesels where low ambient temperatures are encountered. Wear rates and maintenance costs usually rise sharply where winter temperatures drop below practical engine starting temperatures.

Over 11 years ago the Stewart-Warner Corporation recognized the need for a method of starting engines operating in cold climates. More recent progress has brought about the development of a more compact heater. This standard vehicle heater delivers 20,000 btu per hr as clean air heated to 400°F. An additional 10,000 btu per hr may be obtained by utilizing the exhaust from the heater.

Engine Preheating

Here is an engine pre-heater so compact that it can be installed under the hood of a Jeep—A possible answer to the problems of sub-zero operation.


EXIT AIR FROM ENGINE BREATHER
APPLY CLEAN HOT AIR FROM HEATER TO ALL BEARINGS INSIDE THE ENGINE
EXHAUST FROM HEATER WARMS OIL IN SUMP
HOT AIR FROM HEATER WARMS BATTERY IN INSULATED BOX
PRE HEAT DIAGRAM

For preheating, the output of this unit may again be increased by as much as 50 per cent by changing the fuel metering orifices. The heating unit may then be considered potentially able to deliver 45,000 btu per hr.

Advantages

Preheating has many advantages which go a long way in the reduction of maintenance costs and adding years to engine life.

Cold sludge formation is reduced to a minimum along with crankcase condensation and the resultant formation of corrosive aldehydes.

Wear is reduced greatly as positive oil flow is assured in preheated engines. Therefore, oil at the proper viscosity is allowed to flow to all moving parts that would otherwise be damaged by excessive friction.

Rings are expanded as the temperature is raised. Blow-by is reduced and

Illustrated here is a typical piping diagram for preheating. It will be noted that dampers are used to direct the 400° F air to the engine air intake system to aid in starting.

excessive ring-corking minimized as this action takes place.

Cranking resistance is decreased enabling the starter to turn the engine at a higher rotative speed. The higher cranking speed helps to effect a quick start, thereby lowering the power demand on the battery.

In order to bring the power of the battery up to normal, an insulated battery box is used and hot air from the heater is piped into it.

With this system, clean air, heated to approximately 400°F is circulated through the engine. The lubricating oil in the sump may be warmed by the use of a heat exchanger. For this purpose, finned tubing routed through the sump was used successfully in tests. Either clean air or contaminated combustion exhaust from the heater can be used for warming the lube oil.

When the engine is heated sufficiently to permit starting, the clean 400°F air can be directed to the engine's intake manifold. This is done by the use of dampers in the heater piping system.

The use of heated induction air aids combustion by the further heating of the cylinder walls and helps to prevent condensation of fuel vapors in the cylinders. During tests using this system, starts have been effected after only a few revolutions of the engine.

Once the engine has been started, the heater output can be used to heat operating personnel or passengers. This eliminates the need of cab heaters as the single unit can accomplish both jobs efficiently.

Other Types

A unit which found extensive use during World War II, was the Army's D-1 heater. This was a "slave type" heater which was independently operated and could be drawn up to the engine to be started. Heat output was 80,000 btu per hr and power was supplied by a single cylinder gasoline engine.

Since early experiments with this heater were conducted in Alaska, it was soon found that this ground unit required preheating. This brought about the development of a Hand Crank heater. This unit was entirely self contained and delivered 30,000 btu per hr of contaminated air.

Next came the model 904A which was an independently operated portable heater. This heater delivered 100,000 btu per hr of clean air. Following the 904A, came the development of a small coolant heater. This was the first effort in the direction of a compact unit which could be mounted on an engine as standard equipment.

Although developed by Stewart-Warner in close cooperation with military agencies, the pre-heating systems are expected to find wide usage in many civilian fields. Expansion of diesel power into many fields is expected to provide a sizable market for this type equipment.

What Do You Know!

Here, again, is a chance to check your knowledge of various phases of the diesel industry. Select your answers and then compare them with those on Page 77.

1. Which of the following is the most realistic indication of whether an engine is "high speed", "medium speed", or "heavy duty"?

   a. Rotative speed
   b. Maximum cylinder pressures
   c. Piston speed
   d. Engine size and weight

2. For municipal service, high specific output in engines of moderate size offers some practical advantages.

   a. True
   b. False

3. The only advantage of engine preheaters and coolant heaters is to aid starting in extremely cold weather.

   a. True
   b. False

4. Which of the following conditions, considered separately, that could be found in railroad engine-generator sets can result in engine overload?

   a. Excessive voltage
   b. Excessive current
   c. Combination of high current and voltage

5. Which of the following conditions that could be found in railroad diesel-electric equipment could damage the generator and traction motors?

   a. High current
   b. High voltage
   c. Combination of full rated current and voltage

6. Field excitation control is used in railroad diesel-electric equipment for which of the following functions?

   a. Control generator voltage
   b. Limit generator current
   c. Control dynamic breaking effect

7. Shaft currents are sometimes found in large diesel electrical generating units. Certain conditions must prevail before the magnitude of the current is sufficient to give trouble. If you suspected such a trouble, where would you commonly find the indications of such a condition?

   a. On switchgear meters
   b. "Hot" metal parts
   c. Generator support bearings
   d. Engine instruments

8. Suppose that you found the condition in a generator that was direct-coupled to the engine flywheel and supported on a pedestal-type outboard bearing. What action listed below would be the commonest and most practical means of eliminating it?

   a. Insulate the rotor from the crankshaft flange
   b. Ground the generator frame
   c. Insulate the outboard bearing from the pedestal
   d. Insulate the pedestal

9. Is *significant* engine weight reduction possible through the use of aluminum and its alloys?

   a. Yes
   b. No.

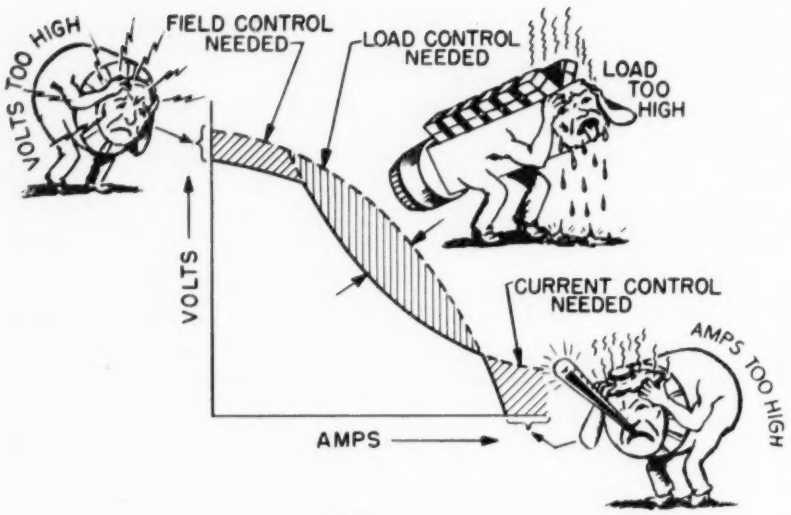


FIG. 1

Fig. 1 How excitation control protects the diesel engine and generator.

Fundamentals of the Diesel-Electric Locomotive

Part III

by J. D. Alrich

Locomotive and Car Equipment Dept.
General Electric Co., Erie, Pa.

The third and last of a three part article presented for the purpose of giving railroad operation and maintenance personnel a more complete understanding of the diesel-electric locomotive.

Fig. 2 A typical three-unit diesel-electric road locomotive for freight and passenger service.

If the control on a diesel-electric locomotive is like the quarterback on a football team then the excitation system may be said to be the umpire. It has been the job of seeing that the main generator and the diesel engine both get a "square deal." Now let's see why it is necessary to have this umpire and how he works.

Under some operating conditions, it would be possible for the generator to overload the diesel engine without overloading itself. Under other conditions, the engine could be operating at a normal load while the generator was badly overloaded.

We must protect both of the machines against damage resulting from such conditions. The excitation system does this by controlling the current in the field winding of the main generator. By this means, it makes the generator work efficiently with the engine at all speeds and loads.

In the section headed "Main Generator," we saw how the generator produces voltage when its field is excited. If the field current (excitation) is low, the generated voltage will be low. If the field current (excitation) is high, the generated voltage will also be high. This gives a handy means of controlling the generator voltage. We only have to arrange the excitation system to vary the generator field current.

If operating conditions demand a current which would overload the generator, the excitation system can be made to weaken the field. This reduces the generator voltage and limits the current to a safe value (Fig. 1). Under other operating conditions, the main generator voltage might become so high it would damage both generator itself and motors. In this case, the excitation system again reduces the field current to hold the voltage to safe limits (Fig. 1).

If either the current or voltage is too high, the generator and motors may be damaged. When high currents or voltages occur separately, however, they have no effect on the diesel engine. On the other hand, there are certain operating conditions when neither the current nor the voltage is high enough to do any damage to the generator but when the combina-

tion of both may be enough to overload the engine.

We see the reason for this when we recall that the engine supplies the power required to drive the generator. This power may be expressed as volts multiplied by amperes. As the need for voltage and current increases, the load on the engine becomes greater. Finally, it reaches a point where the engine can no longer supply the additional power demanded by the generator. It will then begin to stall and overheat, and damage is sure to result if the overload lasts very long.

To prevent this, the excitation system must reduce the generator voltage to a point where the engine is not overloaded (Fig. 1). Once again, it does this by reducing the generator field.

Most diesel-electric locomotives have some form of excitation control which reduces the generator field current whenever an overload forces the diesel engine to slow down. It is easy to make this control automatic by having the engine governor—which always responds to a drop in engine speed—operate a small rheostat. This is called "load control", and it effectively prevents overloading the diesel engine.

Voltage or current overload control was formerly a very difficult job. Within the past few years, a system including these as well as load control, has been developed. For this purpose small electric devices called "saturable core reactors" are used. These are sensitive to either voltage or current overloads. When they detect the existence of either type of overload on the generator, they automatically reduce the field current. With this system, it is possible to protect the engine and generator from practically any type of overload that may be encountered in service.

At first glance a control system such as we have been describing may seem complicated. The question naturally arises, why not have the least amount of simple apparatus that will do the iob? The first reason is safety.

The more nearly automatic the control system is, the more time the engine crew will have to attend to the job of operating the train. The second reason is efficiency. Automatic control does away with the "human element" and assures that the job will be done in the same way every time.

Multiple Unit Operation

Practically all diesel-electric road locomotives, and many switchers also, are so equipped that two or more locomotive units may be operated together and controlled from a single engineman's cab. We call this "multiple-unit operation," and locomotives connected in this way are known as "units."

Road locomotive units are of two types. One, often called the "A" unit, contains an engineman's cab with operating controls as well as an equipment cab. It may be used as a single locomotive, or as either the leading or trailing unit of a multiple-unit locomotive.

The other type, often called a "B" unit, has no engineman's cab and is always used as a trailing unit in a multiple-unit locomotive. Both "A" and "B" units contain diesel engines, main generators, traction motors and control systems. Some "B" units are equipped with a small control station which permits a hostler to move the unit in the shop or yard under its own power.

Various combinations of units may be used to make up a locomotive, but an "A" unit must always be used as the leading or control unit (Fig. 2). All other units in the locomotive are called trailing units. Usually no more than four units may be used in any one locomotive.

The units making up a locomotive are coupled in the same way as the cars in a train. In addition, however, flexible electric cables (called "jumpers") are plugged into receptacles on the ends of adjacent units. These jumpers connect the various control circuits of one unit to the corresponding circuits of the next unit. Air brake lines and (on passenger locomotives) train-heating steam lines are connected by flexible hoses.

In operating a multiple-unit locomotive, the engineman moves his control levers in the same way as on a single-unit locomotive. By means of the jumpers, the leading unit sends current through the proper control wires to all the units.

The apparatus on all units operates as called for by the position of the engineman's levers in the leading unit. All units respond instantly to any movement of the control levers. Each unit does an equal amount of the work, providing all are of the same horsepower rating.

It is possible to make up a number of different combinations of units. Some of the arrangements in frequent use are illustrated in Fig. 3.

When switching locomotives are operated in multiple, the units are usually all alike and any one of them may be used as a leading unit.

The multiple-unit system of operation permits varying the horsepower of a given locomotive within certain limits. This has definite operating advantages. For instance, suppose a certain train can be hauled at required speeds over a division in flat country by a two-unit locomotive.

If the next division contains grades, it is only necessary to add one or two units at the division point, and the train can continue at required speed over the hills.

Dynamic Braking

In dynamic braking the operation of the traction motors is reversed so that they hold the train back instead of pull it. This can be done by a simple change in the motor connections. As we have already learned, electric motors and generators are basically the same. Therefore, we can make a motor act as a generator by using suitable electric connections and driving it from some source of power. This is what is done in dynamic braking.

When the engineman moves his selector handle into the braking position, he causes a power switch to operate. This switch is called the "braking switch" or "cam switch". It disconnects the field winding of each traction motor from its armature and then connects all of the field windings to the main generator (Fig. 4).

The generator forces current through the motor fields. The momentum of the train pushes the locomotive and causes the motor armature to revolve.

With the fields excited and the armature revolving, the motors act as generators. The output of the motors must be taken up in some way or they will not brake the train. To take care of this, the braking switch connects the motor armatures to a set of resistors (Fig. 4).

The voltage developed by the motors (acting as generators) forces current through the resistors. Because this acts as a load on the motors, they tend to slow down and, as a result, brake the train.

Dynamic braking pleases the operating people for another reason also. The number of cars which must be taken out of trains because of defects resulting from the continued use of air brakes in hilly country is greatly reduced.

The weight of train that can be handled by a locomotive in dynamic braking is limited by the capacity of the motors and braking resistors. The loadmeter at the engineman's position is arranged to show the current flowing from the motors to the braking resistors.

The motors must not be overloaded during braking, so the current must be reduced when it exceeds the safe limit. This is shown by the needle of

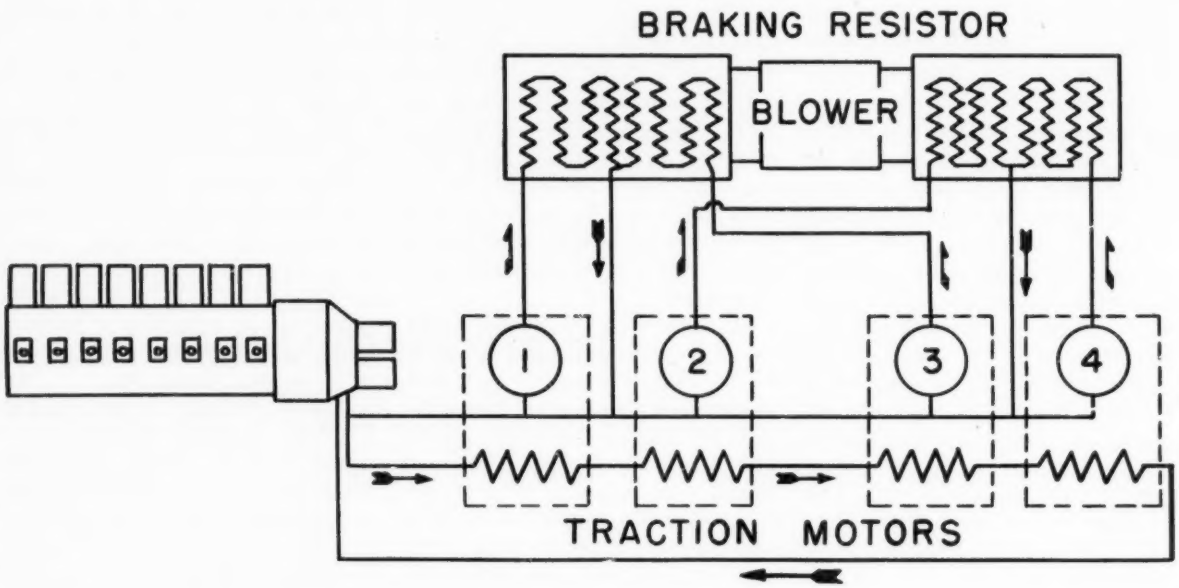


FIG. 4

Fig. 4 Connactions for dynamic braking on diesel-electric locomotives.

Fig. 3 Arrangements of diesel-electric locomotive units commonly used on American railroads.

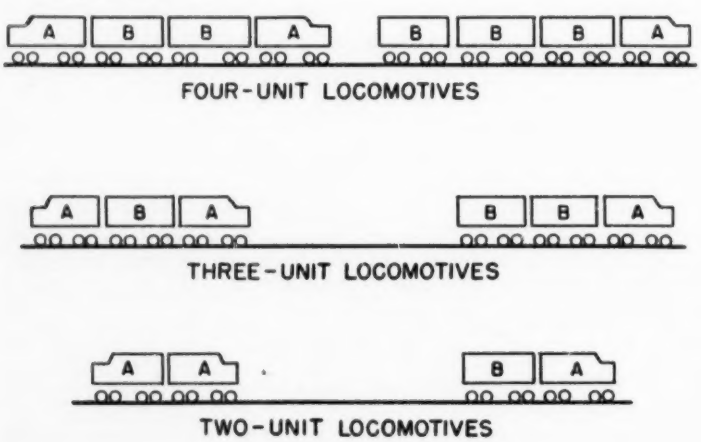


FIG. 3

Fig. 5 In dynamic braking the job of the locomotive is reversed and it holds back against the push of the train on the down-grade.

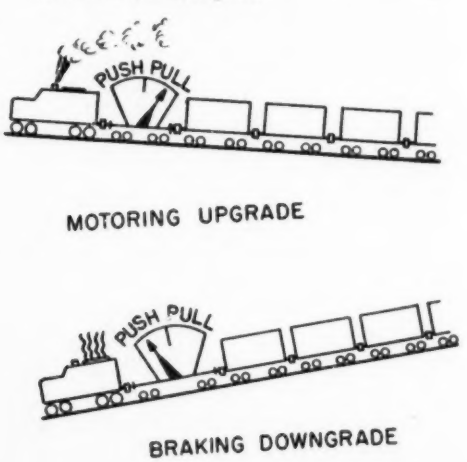


FIG. 5

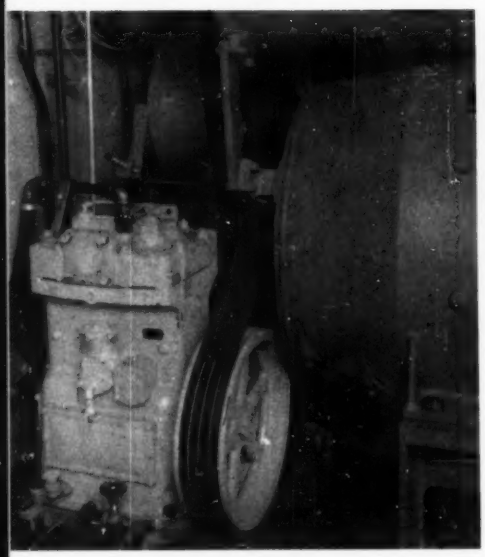


Fig. 6 A locomotive air compressor driven from the diesel engine-generator set by V-belts.

the load meter entering the red band on the braking scale. A lamp is lighted to warn the engineman when the overload occurs. He must move the selector handle back until a safe value of motor current is again reached.

On the latest locomotives, the control system automatically holds the braking current to a safe value. With this control the engineman simply sets the control handle in maximum braking position. It is no longer necessary for him to watch the load meter. In general, a locomotive will safely handle any train in dynamic braking on a down grade that it can haul up the same grade without exceeding its rating (Fig. 5).

There is nothing really new in the idea of dynamic braking. It began years ago with the use of "regenerative braking" on railroads operating electric locomotives. With this form of braking, the power generated by the motors is returned to the trolley wire instead of being absorbed by resistors.

With the General Electric system of control, dynamic braking can be used down to very low speeds. This means that trains can not only be held on down grades; but also slowed down for stops, even in flat country, by dynamic braking.

In this system, the selector handle actually operates a rheostat which controls the exciter field current. When the engineman moves the handle forward, the exciter field current, and hence the generator voltage, is increased.

This higher voltage sends more current through in the traction motor fields. As a result, the locomotive braking power is increased. When he pulls the selector handle back, the exciter field current is reduced and braking power is decreased.

By controlling the small current of the exciter field, the engineman is able, easily and accurately, to regulate the large current output of the traction motors.

The braking power of your automobile engine on a hill depends on what gear you are in. Just so the maximum braking force developed by a locomotive depends upon the traction-motor gear ratio. It is greater on low-geared than on high-geared locomotives. On the other hand, the speed at which maximum braking is developed is higher on high-geared than on low-geared locomotives.

For instance, the 65-mph locomotive in the table at the end of Part I develops a maximum braking effort of 40,500 pounds at 18 mph, while the 117-mph locomotive develops a maximum of 22,750 pounds at 33 mph. With the G.E. braking control system, the 65-mph locomotive has 5000 pounds braking effort available at 3 mph.

Air Brakes

About 1870, the wise folks were laughing at a young man named George Westinghouse, who "had the crazy notion he could stop a train with air."

In spite of the jokes and jeers, he went ahead and showed that his scheme would work. He fitted a locomotive with an air compressor and a storage reservoir where air was held under pressure. On each car of the train, he had a brake cylinder which was connected through piping and hoses to the locomotive reservoir.

To stop the train, the engineman simply moved the air brake control valve and let air from the reservoir into this train-line pipe. As the air entered the brake cylinders on the cars, it forced the pistons to move and applied the brakes. This original scheme is still in use and is called the "straight air" system. It has the disadvantage that any leaks in the pipes or hoses allow the air to escape and the brakes fail to work.

To overcome this objection, Westinghouse invented the automatic air brake in 1872. This system, with refinements, is in use today and is the standard on American railroads.

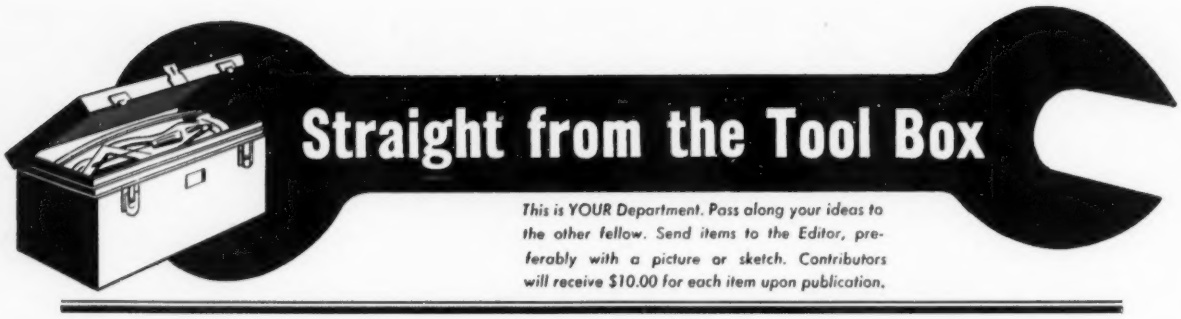
A compressor supplies air under pressure, as in the earlier system. The main difference is that each car in the train, as well as the locomotive, carries a reservoir where air is stored. The air is held in the reservoir by a pressure-operated valve called the "triple valve."

As with the straight air system, the locomotive and all the cars in the train are fitted with a train-line pipe and have flexible hose connections between the cars. The triple valves on the cars are normally held closed by air which is pumped back through the train-line by the locomotive air compressor. To apply the brakes, the engineman moves his air brake control handle to the braking position.

This opens a valve which allows air to escape from the train-line. As the train-line pressure is reduced, the pressure of the air in the car reservoirs forces the triple valves to open. Air from these reservoirs rushes into the cylinders and applies the brakes.

If air brakes are applied to a wheel which is already being slowed by dynamic braking, it would probably lock and slide. This is prevented by an automatic interlock between the two systems. If, while using dynamic braking, the engineman makes a normal application of air; the train brakes operate, but the air brakes on the locomotive do not. If he makes an emergency application, however, all air brakes operate and dynamic braking is automatically cut off.

In the case of small switching locomotives, the straight air system is used with brakes on the locomotive alone. Larger switchers and all road locomotives are equipped with the automatic system. On diesel-electric locomotives, the air compressor is driven directly from the diesel engine (Fig. 6).



Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

Before getting to this month's business, we have further word from J. Quiros L., Costa Rica, whose report on "Repairing a Crankshaft the Hard Way" was published in April, 1952. First, the old decimal point trouble. We had the journal 0.83 in out-of-round when it should have been 0.083. Either way, it's a lot of hand filing.

Next, we commented in the Editor's Note, on the bearing used. Our interpretation of the phrase, ". . . U. S. bronze bearings . . .", was given a nationalistic flavor. Now we find that the initials meant "undersize" and that the bearings were of solid bronze. We do not know the specification of the bronze, but it strikes us as pretty rough treatment of an unhardened shaft. High shaft wear rate is predicted. If it were us, we would either bond a thin layer of babbitt on the bronze (after undercutting) or bore some unfinished stock bearings to proper size. Even aluminum, so successfully used by Ingersoll-Rand, might be better—Editor.

Flat Lapping Stops GM Injector Leaks

H. D. Allen, Jr., El Campo, Texas—In servicing GM injectors, I often find that leakage occurs between the lapped sealing surfaces of the injector tip head, spacer plate and barrel base during high pressure testing after re-assembly. When this occurs, it is necessary to disassemble the unit for checking.

To overcome the possibility of this high pressure leakage, I hand-lap all these surfaces with a very fine lapping rouge during overhaul, "just in case". It takes a little more time, but is worth it in the long run. The lapping is done on a true-surface piece of plate glass. After lapping, I wash the surfaces thoroughly in clean kerosene, blow off with dry, high-pressure air and dip in clean diesel fuel before reassembly.

Very often new parts have become pitted from minute particles of moisture collecting on the contact surfaces while in stock. The condition is hard to detect unless the parts are examined under a strong magnifying glass. Lapping of these new parts is also practical to insure a true seal when installed. By eliminating leakage at these points, it is easier to detect the pressure of plunger and check valve leaks.

(Sound advice from a fellow who should know. We find that he runs an injection repair shop. His customers should be happy with this evidence of extra care. We might comment that we prefer a lapping plate to the plate glass. We have frequently used the latter as an expedient—yes, and toothpaste and cigarette ashes as a lapping compound—but prefer the lapping plate and the uniform abrasiveness of the commercial rouges.

He might also have gone on to say that testing fixtures available today help to locate high-pressure leaks. A clamp blocks the orifices while the pressure pump is used to build up the pressure [fuel return outlet must also be blocked]. Rate of leak-off [normally past the plunger] will greatly increase with mating surface leaks. Oil will sometimes be forced out past the threads on the injector nut. Watch, too, that the lapped surfaces are not blamed for leaks caused by dirt between the faces—Editor.)

Graphite Paste for Exhaust Manifolds

Willard G. Wilcox, Avery, Idaho—Twenty-two years ago, I started using graphite paste to replace exhaust manifold gaskets where they were hard to hold without leaking. The practice has been used on aircraft engines, automobile, truck and tractor engines—gasoline or diesel. It makes no difference.

First, clean the mating surfaces thoroughly to remove the old gasket, carbon and burrs. This work must be well done. Apply a generous coating of graphite paste and bolt the manifold into place. Start the engine and retighten after the parts get hot.

On Caterpillar equipment, where two gaskets are used, I make a metal filler plate that is the thickness of one gasket so that all the parts will come together. I use no gasket, just the paste.

One thing to remember is that this will not cure leaks due to warped manifolds or blocks. These surfaces should be machined or ground flat or replaced.

(Graphite paste has been known to be very effective for this use in conjunction with gaskets. There is no reason why it should not work alone, providing the metal-to-metal fit of the mating surface is good. It will fill in all of the minor irregularities and bake hard—Editor.)

50-TON HAULS with WAUKESHA *Diesel*

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Here it is again — the truckers' Diesel — making more miles and putting out peak payload performance for Crail Transportation Co. of Long Beach, California. It's hauling heavy oil field machinery . . as high as 100,000 lb. gross weight . . . over mountain roads. "This engine has been very satisfactory in every way, and has met all our requirements fully," says Mr. A. W Swanson, Crail's president and general manager

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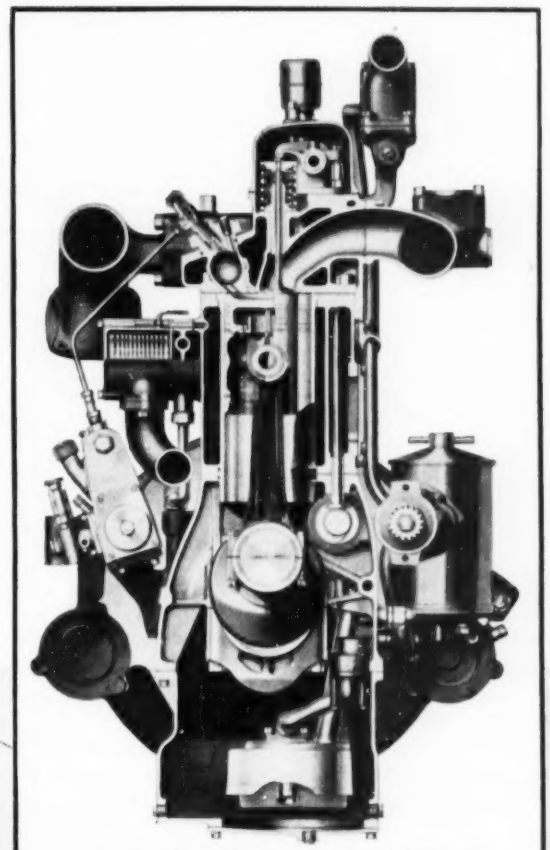

WAUKESHA High-Duty DIESEL Model 148-DK six-cylinders, 5¼-in. bore x 6-in. stroke, 779 cu. in. displacement. Peak hp 200.

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New Products

Heavy Duty Switcher

The new locomotive is a further development of the GM road switcher type, already represented by the GP7 and the military road switcher recently developed for the United States Army Transport Corps. The SD7 is designed for the heaviest tonnage special duty assignments. The new locomotive is unique in its class in that its fully flexible truck permits eighty-mile-an-hour passenger operation as well as mainline freight, transfer, humping and yard switching service. It further extends the benefits of diesel operation to districts where high tractive effort with light axle loading is necessary.

Outstanding features of the SD7 include a new wheel-slip control system that actuates an automatic sanding device; new high-capacity dynamic brakes; and maximum interchangeability of parts with other GM diesel locomotives. The operator of the SD7 enjoys exceptional visibility from a cab.

Comfort and convenience are featured, with forced-air ventilation for summer and individual temperature controls for winter. He has complete control of starting tractive effort, with velvet-smooth acceleration assured by fully automatic transition. Steam generator equipment, of 2500 lb capacity and 1200 gal water supply, is available for passenger car heating.

Miniature Mounted Wheel

The Chicago Wheel and Manufacturing Company, Chicago, Illinois, are now producing what they believe to be the world's smallest commercial mounted wheel.

This miniature wheel, 1/16-in in diameter, is used for grinding extremely small holes in miniature bearings, bushings, instruments, and for similar precision applications. The manufacturer claims that exact duplication of even the most minute parts is now possible with this new development in the abrasive field.

New Inspection Technique

The technique of "hot radiography" permits the taking of X-ray photographs of large pipes, valves, and similar units at temperatures as high as 1200° F. This process, called the McElroy-McNutt hot radiography process, has been applied to the inspection of partially completed welds on hot sections of pipe to check for possible welding defects.

Hot radiography, which can be accomplished on a hot pipe, makes it practical to interrupt the welding operation to inspect the weld root where most flaws occur. This technique, therefore, saves the many manhours of heating and controlled cooling that were formerly required before the weld could be inspected. Additional time is saved, because, if defects are found, it is necessary to chip away only a partially-completed weld, rather than a finished weld.

Further information about this process can be obtained from Sam Tour & Co., Inc., 44 Trinity Place, New York 6, N. Y.

New Air Flow Snubber

King Engineering Corp. of Ann Arbor, Michigan, announces a new air flow snubber and pulsation damper. This unit provides a controlled slow rate of flow of compressed air or gas for operation of continuous-reading hydrostatic instruments and for purging pneumatic instrument tires.

It protects pneumatic testing and gauging equipment against damage that might result from surge pressures, by providing a flow restriction in the line. The snubber is also used as a pulsation damper for pressure gauges, recorders, manometers, etc. Placed in line between the instrument and the pressure source, the snubber damps or smooths out pulsations so that the instrument gives a steady reading.

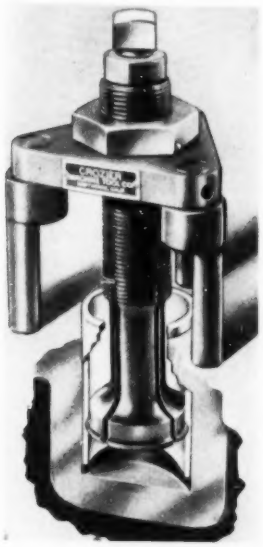
The snubbing action is accomplished by passing the air or gas through a helical restricting passage around the threads of a screw, at right angles to the snubber body. With normally clean air or gas, this re-

stricting passage remains clear indefinitely. If plugged by dirt or moisture, the snubber is put back in operation by removing and cleaning the snubbing screw, without disconnecting from the line.

The snubber is made of hexagonal brass rod throughout except for a neoprene O-ring used to seal the screw. Flow rate is approximately .04 cu ft per minute at a pressure drop of 70 psi, and maximum operating pressure is 1000 psi.

Bushing and Bearing Extractor

The Crozier Machine Tool Company, 684 North Prairie Avenue, Hawthorne, California has developed a bushing and bearing extractor for blind holes, "engineered on an entirely new principle".



A saving of as much as 75 per cent of labor time in extraction, is claimed. The company's extractor eliminates the necessity of machining bearings and minimizes the hazard of injuring casings or excessive dismantling of equipment.

It consists of eight threaded expanding arbors, a draw table with two sets of legs (short and long), adjustable as to distance from work, and can handle any hole from ½ to 2-in diameter. A maximum of 2½ in may be drawn at one setting and press fits of over five tons are claimed to have been extracted readily with this unit.

3-Jaw Lathe Chuck

The latest addition to the line of lathe chucks made by Westcott Chuck Company, Oneida, New York, is the No. 6907, six-in, three-jaw universal chuck, with threaded body back for direct mounting on machine tools with 2¼ to 8-in spindles.

Since no adapter is required, the chuck is mounted close to the spindle bearing, thus minimizing chatter which may be caused by excessive overhang.

Redesigned Wrench

A redesign of the pipe wrench put out by Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 46, Wisc., enables users to replace worn gripping surfaces with jaw inserts at approximately one tenth of previous costs.

Formerly, an entirely new upper jaw was purchased when teeth became worn. The redesigned wrench is made with inserts which are interchangeable in upper and lower jaws and there is no longer need to scrap

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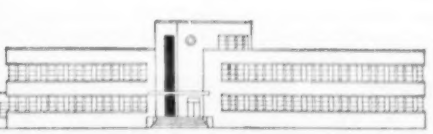
Battery Ignition Applications. Opens battery circuit and sounds an alarm . . . sounds an alarm only . . . opens battery circuit only.

Magneto Ignition Applications. Sounds an alarm only . . . grounds dual magneto . . . grounds magneto only . . . grounds magneto and sounds alarm or lights signal light.

Dual Ignition Applications. Opens battery circuit and grounds magneto.

PENN



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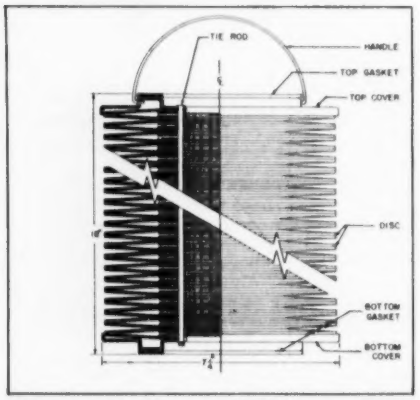


New, Patented FLOmaster Cartridge is a Glutton for Dirt, A Bear for Work

Diagram, above, shows the compact arrangement of paper disc assemblies which pack 45 square feet of filtering area into each FLOmaster cartridge -- a new high! You're assured dirt removal for longer periods, longer service between replacements.

To meet your requirement for *full* protection of bearing surfaces against engine wear, Hoffman has designed this new-full-flow FLOmaster. Removes abrasive particles at high flow rates, with minimum pressure loss, by means of exclusive patented FLOmaster cartridges. In each 7" x 18" cartridge is filtering area of 45 sq. ft. to provide unmatched dirt-holding capacity, longer useful life between changes.

Your choice of ten sizes, with flow rates from 75 to 900 gpm. All available with the Hoffman unique cover-lifting feature that simplifies and speeds cartridge replacement. Write for new FLOmaster bulletin A-873 *now*.

INDUSTRIAL FILTRATION DIVISION

U.S. HOFFMAN MACHINERY CORPORATION

214 LAMSON STREET, SYRACUSE 6, N. Y.

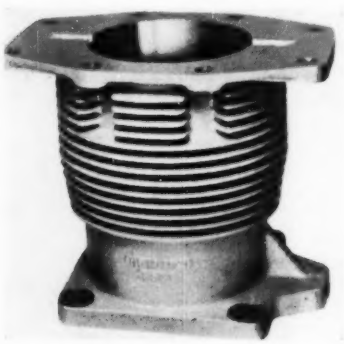
CANADIAN PLANT CANADIAN HOFFMAN MACHINERY CO. LTD. NEWMARKET ONT.

the upper jaw assembly because of a worn gripping surface.

Existing Ampco pipe wrenches can be modernized by obtaining the "B" upper jaw assembly with new inserts at the regular price of the "B" part. Only inserts need be purchased thereafter.

Replacement Cylinders

A new line of replacement cylinders for diesel locomotive air compressors has recently been introduced by Hunt-Spiller Manufacturing Corporation, 383 Dorchester Avenue, South Boston 27, Mass.



The cylinders, made of gun iron, provide several new features. Approximately 42 per cent has been added to the area of the heat-radiating fins. This area has been concentrated at the head end of the cylinder, where greatest heat dissipation is required. A reduction in temperature is realized. Gun iron has a dense pearlitic structure and the cylinders made of this material have long life service and even-wearing qualities, it is claimed.

Steam Cleaning Compound

A free rinsing, readily soluble liquid steam cleaning compound, Turco 3232, which is safe on reactive metals and painted surfaces, is a recent development of Turco Products, Inc., 832 East 62 Street, Los Angeles 1, California.

The liquid is non-hazardous and non-inflammable, it is claimed, and affords efficient, speedy, economical removal of light to medium soil deposits and is very free rinsing. Since it is liquid, it goes into solution more easily than powdered materials. Its

emulsifying action enables oil and grease-bound dirt to be freely rinsed away. It is stable and will not settle out.

The material has been tested and approved for use by Air Materiel Command, Wright Field. It meets the corrosion requirements of Air Force specifications as non-corrosive to aluminum alloys, anodizing and reactive metals. It gives scale-free operation except in the very hardest of water and emits no disagreeable fumes or objectionable odors.

Signal and Alarm Panels

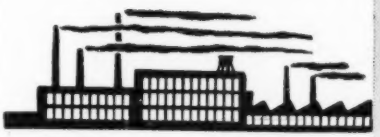
Auth Electric Company, Inc., 34-20 45th Street, Long Island City 1, New York has just developed an engineers' signal and alarm panel. It is designed to supervise the operating condition of lubricating and fuel oil booster pumps, turning and steering gear systems, service and circulating pumps, salinity content equipment, and similar systems.

Operation of any of the supervisory contact makers installed at equipment, immediately illuminates warning signals on the alarm panel indicating the location of the abnormal condition.

For those circuits requiring an audible warning signal to sound with the visual signal, a vibratory horn is provided.

The panels are built to AIEE Specification No. 45. They are sheet steel,

Like having a tool store right at your door!



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SNAP-ON SERVES INDUSTRY EVERYWHERE THROUGH THESE 42 FACTORY BRANCH WAREHOUSES

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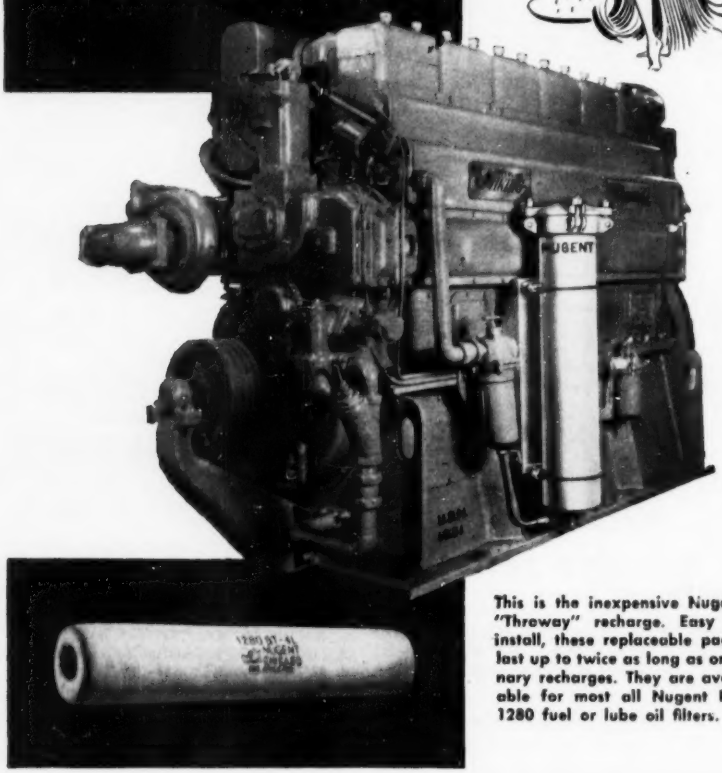
CHARLOTTE 6, N. C., 915 S. Clarkson St.
CHICAGO 7, ILL., 120 N. May
CINCINNATI 6, OHIO, 605 E. McMillan St.
CLEVELAND 15, OHIO, 2912 Euclid Ave.
DALLAS 1, TEXAS, 2932 Commerce St.
DENVER 3, COLO., 1050 Broadway
DETROIT 2, MICH., 93 Piquette Ave.
EDMONTON, ALBERTA, 10232 103rd St.
FARGO, N. DAK., 421 N. P. Ave.
HOUSTON 3, TEXAS, 1810 LaBranch St.
INDIANAPOLIS 2, IND., 848 Fort Wayne Ave.
JACKSONVILLE 6, FLA., 1602 Walnut St.
KANSAS CITY 2, MO., 3635 Main St.
LONDON, ONTARIO, 111 Mt. Pleasant Ave.
LOS ANGELES 14, CALIF., 1717 W. 6th St.
MILWAUKEE 3, WIS., 2600 W. State St.
MINNEAPOLIS 3, MINN., 1218 Harmon Place
MONCTON, NEW BRUNSWICK, 33 Mechanic St.
MONTREAL 15, QUEBEC, 751 Jean Talon St. West
NEWARK 6, N. J., 823 Sandford Ave.
NEW ORLEANS 13, LA., 1040 Camp St.
NEW YORK 56, N. Y., 397 East 167th St.
OKLAHOMA CITY 3, OKLA., 901 N. Hudson St.
OMAHA 2, NEBR., 109 S. 24th St.
PHILADELPHIA 30, PA., 1710 Fairmount Ave.
PITTSBURGH 8, PA., 7007 Kelly St.
REGINA, SASK., 2070 Albert St.
RICHMOND 20, VA., 1617 West Broad St.
SAN FRANCISCO 2, CALIF., 635 Golden Gate Ave.
SEATTLE 22, WASH., 1501 Olive Way
ST. LOUIS 3, MO., 2647 Washington Blvd.
SYRACUSE 3, N. Y., 323 Irving Ave.
TOLEDO 6, OHIO, 2932 Monroe St.
TORONTO 17, ONT., 130 Laird Drive
VANCOUVER, B. C., 1043 Davie St.
WINNIPEG, MANITOBA, 238 Garry St.

Ever needed tools *fast?* What plant hasn't? To meet just such emergencies—as well as the year-'round normal tool needs of all Industry—Snap-on maintains the 41 factory branch warehouses listed here. The complete Snap-on line offers more than 4000 tools for industrial production and maintenance. Snap-on factory branches make them quickly available to factories and shops everywhere. Snap-on branches are staffed with tool specialists experienced in the needs of industry. A phone call brings Snap-on service right to your door . . . *try it!* For latest Snap-on Industrial and General Catalog, write—

SNAP-ON TOOLS CORPORATION, 8064-I 28th Ave., Kenosha, Wis.

A complete national tool service
.... Engineering
.... Manufacture
.... Distribution

THIS NUGENT FILTER helps keep Navy radio *on the air* in the South Pacific



This is the inexpensive Nugent "Throway" recharge. Easy to install, these replaceable packs last up to twice as long as ordinary recharges. They are available for most all Nugent Fig. 1280 fuel or lube oil filters.

The Nugent Filter on this Sterling 6 cylinder super-charged 400 K.W. diesel-electric generator plays an important part in keeping things humming at one of Uncle Sam's South Pacific radio stations. The Nugent Filter contributes to this vital operation by keeping lube oil impurities away from the engine's working parts, filtering out 99.8% of the dirt. This is the kind of filtering protection that really pays off with longer engine life, less maintenance, substantial oil savings—and most important in an installation of this type—greater dependability. Nugent lube oil filters like the Fig. 1280 CP used here come in a wide range of capacities to fit your particular needs. Write for full details.

NUGENT TRADE MARK

Wm. W. *Nugent* & Co., Inc.

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OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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Established 1897

treated to resist corrosion, and are of drip proof construction. Units are available in AC or DC in any number of circuits.

New Sier-Bath Internal Gear and Bearing Type Screw Pump

A new internal gear and bearing type screw pump for positive displacement of lubricating fluids or semi-fluids is announced by the Sier-Bath Gear and Pumps Co., Inc., 9252 Hudson Blvd., North Bergen, N.J. Capacities range from 1 to 70 gpm, and discharge pressures are 1000 psi for viscous liquids, and 500 psi for light oils.

Special points of interest in the new product are: the heavy duty roller bearings just inboard of the timing gears where radial load is heaviest, lock nuts behind the timing gears for faster and simpler repairing, and double-row angular contact ball bearings at the rear end which position the rotors axially for less wear on the bearings and timing gears.

Low-Cost Giant Brain

A new "giant brain" which has a controlled memory capacity of 102,400 nine-digit words and the ability to solve a 10-digit mathematical problem in 3 milliseconds, was unveiled recently by the Electronic Computer Corporation, 160 Avenue of the Americas, New York 13, N. Y. The Elecom 100, as it is called, is the first low-cost, general purpose, electronic computer of its type to be offered on the market.

It is the first of its type which will be mass-produced for use by business and industry, it is announced, and the lowest priced, fully electronic digital computer available. It sells for $62,500 and was designed for use by scientists and engineers in industrial research laboratories.

The new computer consists of three units, a conventional-type office desk at which the operator sits, a metal drum unit the shape of a water cooler, and the computer proper which is housed in five steel cabinets joined together in a semi-circle. It operates on standard 120 volts AC and can be moved about since the units are mounted on casters.

New Literature

Developments in Precision Investment Casting Process

The latest technical methods in use in the "lost-wax" or investment process for producing precision metal castings, are presented in a report released by the U. S. Department of Commerce.

The investment casting process uses expendable wax pattern surrounded by silica refractory molds for casting metals closely to finished dimension. This antique process was revived and expanded in recent years to produce dental castings, jewelry, and especially jet engine parts that cannot be readily forged or machined. It is also used to save tooling time and expense in making small intricate parts of mechanisms in common steels and nonferrous metals.

The process has shown further advance since World War II. Prepared by a research metallurgist of the OTS, this report discusses: history, uses, process details, precision attainable, and limitations of the process. Especially valuable is an extensive bibliography which lists literature references, government reports, and books on this and related casting methods.

The report is entitled, "Investment Precision Casting", is 13 pages, and may be obtained for 25¢ from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

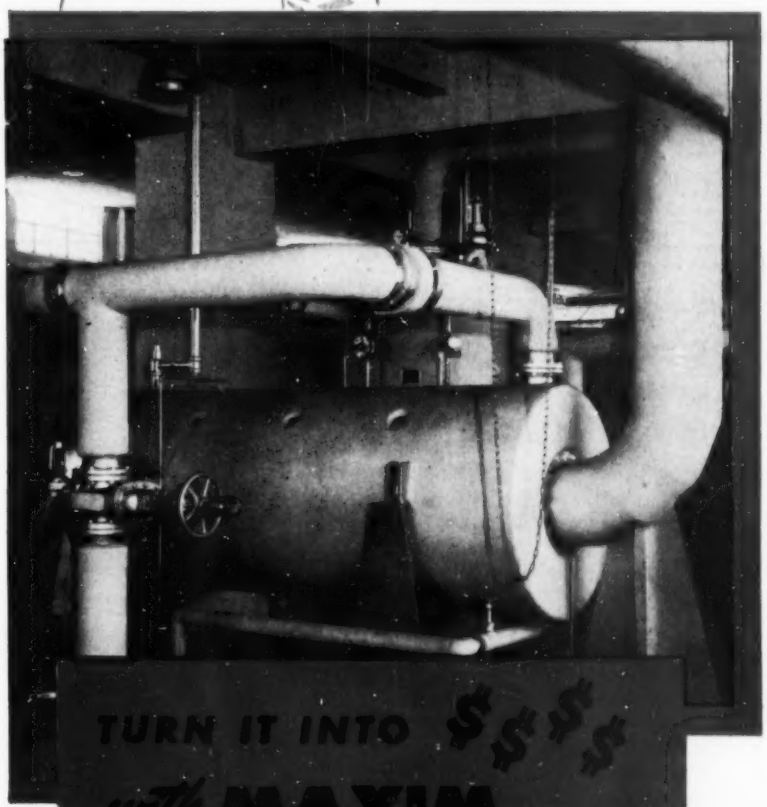
New Survey of Fatty Oils

The Texas Company, 135 East 42nd Street, New York, New York, has just published a book, "Properties of the Principal Fats, Fatty Oils, Waxes, Fatty Acids and their Salts", by M. P. Doss.

This book should be of interest to fatty oil, petroleum and chemical industries, and to manufacturers of lubricants. In its 244 pages, the publication covers the properties of approximately 50 of the principal fats, fatty oils, and waxes, and surveys and tabulates the properties of more than 800 aliphatic acids.

Data is given on the salts of fatty acids ranging from aluminum through

DON'T WASTE EXHAUST HEAT



TURN IT INTO $$$$

with MAXIM HEAT RECOVERY SILENCERS

Consult MAXIM

THE MAXIM SILENCER COMPANY
Dept. W.L., 93 Homestead Ave., Hartford 1, Conn.
Gentlemen:
Please send me your bulletin on Heat Recovery Silencers.
Name _____
Company _____
Address _____
_____

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zirconium. Approximately 1750 salts are listed, material which has never previously been compiled, and includes considerable unpublished data.

A result of ten years of intensive search through published and unpublished data and literature, the book's scope is indicated in its more than 1350 literature references. The book concludes with pertinent conversion tables and a detailed subject index.

Finned Tube Exchanger Bulletin

The Griscom-Russell Co., manufacturers of heat transfer apparatus, located in Massillon, Ohio, has recently published a bulletin on a finned tube heat exchanger with a particularly wide application for heating and cooling liquids and gases, and for condensing vapors.

The bulletin describes this exchanger, known as the G-R Twin G-Fin Section, and explains the features of its design and construction, which the company states, have proved effective in installations totaling more than 70,000 sections. Complete construction details, specifications, dimensions, and installation arrangements of these standard interchangeable units are included. The bulletin contains illustrations of representative installations on various types of duties, together with field reports of service records.

Cartoon-Type Booklet For Maintenance Practices

Maintenance practices are simplified for operators of the DW21, DW20, and DW10 tractors of the Caterpillar Tractor Company, Peoria, Ill., with the issuance of a multi-color, cartoon-type booklet.

The booklet (form 30275) will be available throughout the world, and will be published in English, French, Spanish, and Portugese.

Using scenes familiar to the operator, the booklet discusses factory-prescribed techniques in caring for the above listed tractors. Reduction of repair bills and elimination of down-time, is the purpose of the hand-

another ***important*** * diesel installation

gets

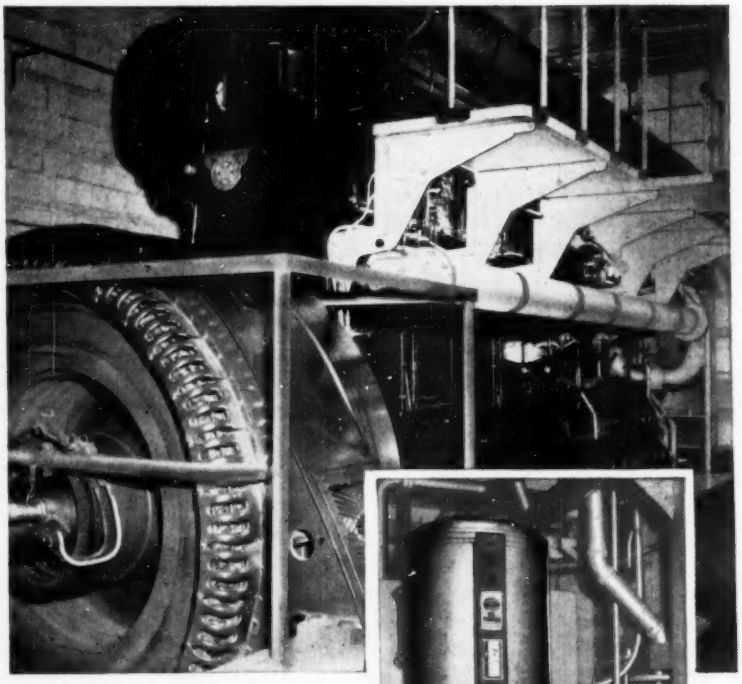
HONAN-CRANE

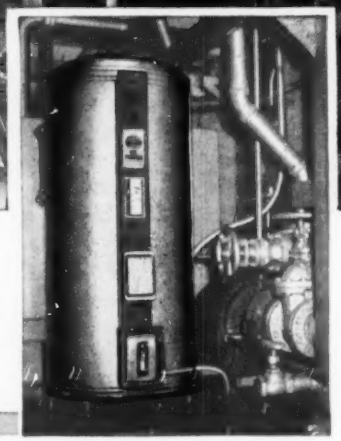
Oil Purification

In the three diesel installations at The International Latex Corporation, Dover, Delaware, every detail has been planned for maximum efficiency and economy of operation. That's Why Honan-Crane Lube Oil Purifiers *again* are first choice for dependable protection against breakdown and excessive wear caused by contaminated oil.

Honan-Crane Oil Purification (for either inhibited or straight mineral oils) protects bearings, cylinder walls and other finely machined parts from improper lubrication and costly damage often caused by solid abrasive contaminants . . . or by acids, gums, resins and other products of oxidation.

Write today for complete information about Honan-Crane Diesel Fuel and Lube Oil Purifiers.





* **40% recovery** of traditionally wasted engine heat is the amazing accomplishment of newest diesel installation at International Latex Corp. Shown above is the 1700 hp. Cooper-Bessemer protected by Honan-Crane continuous lube oil purifier at right. Two other Cooper-Bessemers also are served by Honan-Crane purifiers.

WORLD LEADING OIL FILTER MANUFACTURER

HONAN-CRANE CORP., 305 Wabash Avenue, Lebanon, Indiana

A Subsidiary of **HOUDAILLE-HERSHEY CORPORATION**

ALL HONAN-CRANE EQUIPMENT IS SOLD ON A PERFORMANCE GUARANTEED BASIS

book, dealing with many specific procedures in connection with routine maintenance.

Set Screw Combination

A combination catalog and reference book on set screws, embodying 20 pages of data, has just been issued by Set Screw & Mfg. Co., 1101 Main St., Bartlett, Illinois.

As a catalog, the new book contains illustrations and descriptions of the various types of standard and self-locking set screws, accompanied by data on dimensions, prices, heads, points, and materials, covering the company's entire line.

From a ready reference standpoint, the book offers thread standard tables, standard fit definitions, and other technical data on set screws.

Diesel Traction Repair Movie

A 10-minute sound motion picture entitled, "Make Your Diesel Traction Repairs Stay Repaired", has just been made available by the Westinghouse Electrical Corporation.

The film follows a diesel-electric traction motor through a shop, typical of the repair shops maintained by this company. Standardized repair procedure, dependable workmanship through quality control, speed, and economy are illustrated as the motor is inspected, repaired, and tested.

Those wishing to make arrangements for showing this film, are advised to contact their local Westinghouse representative or write the Westinghouse Electric Corporation, Film Division, Box 2099, Pittsburgh 30, Pa.

New Pocket Size Data Books

Newly revised data books on engineering subjects is announced by Lefax, publishers, in their dollar data book series. A free catalog with over 2000 listings may be obtained by writing Lefax, Philadelphia 7, Pennsylvania.

The books contain about 140 loose-leaf pages of up to date material arranged for ready reference. A partial listing includes: diesel engineering, pumps and turbines, machine design, power transmission machinery, metals, and piping data.

WESTON -TAG Thermometers

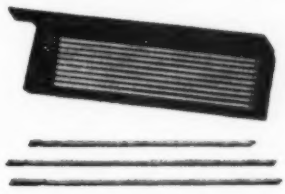
in all forms—ranges—stem lengths—connections

Whether your requirement calls for certified laboratory thermometers . . . or rugged all-metal industrial types . . . or thermometers for remote reading . . . you'll find *exactly* what you require in the Weston-TAG line—*the most comprehensive line of quality thermometers ever offered by ONE manufacturer.* Literature on request. WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

Laboratory

ALL-METAL

—have readable, dial-type scales and corrosion-resisting stainless steel stems—stem lengths from 2" to 24"—ranges from low as −100°F. to high as 1000°F.—accuracy ½ of 1% of thermometer range.



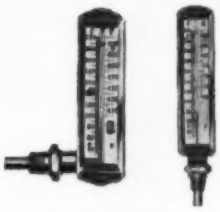
GLASS

—certified sets of ASTM Testing thermometers with overlapping ranges in protective case. Ranges from −36°F. to high as 760°F. Also precision and standard etched stem thermometers for general testing.

Industrial

ALL-METAL

—provide unmatched readability and durability—accuracy within 1% of thermometer range. Available in all types, ranges and stem lengths (2½" to 72") for all requirements.



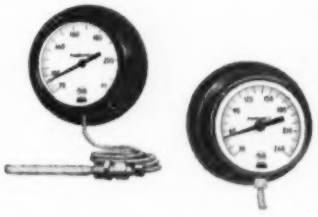
GLASS (Metal Case)

—available in all forms, all ranges, stem lengths and connections. Accuracy within one scale division. Also submarine types, metal and cupcase thermometers.

Remote Reading

ELECTRICAL

—resistor bulb sensing element permits mounting indicator any distance away from point of measurement. *Multiple* remote readings also possible by use of selector switch and several bulbs.



PRESSURE ACTUATED

—for remote reading, in 5, 6 and 8" dial sizes. Ranges from low as −325°F. to high as 1000°F. Accuracy one scale division unaffected by vibration or severe shock. Cases of iron, brass, or plastic.

WESTON Temperature Instruments

—TO INDICATE — RECORD — CONTROL

9413

MAINTENANCE REPORT

HOW MUCH PRESS-FIT Should Be Used in Replacing Pressed-in Valve Seats?

"PETE" PETERSON

"NO ONE KNOWS" . . .

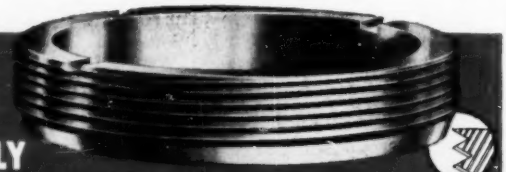
says "Pete" Peterson: Throughout the country maintenance men and engineers *disagree* on proper press-fit tolerances for any specific job. The amount of press-fit to use cannot be determined accurately . . .

BECAUSE . . .

(1) Engine operating conditions vary. (2) Liming conditions in water jackets of engines vary. (3) Different wall thicknesses around the seat cause varying amounts of distortion and expansion in the cylinder head or block (4) Difference from new engine clearances cause different engine operating temperatures.

Proof! All mechanics say the pressed-in seat looks like this before they start to grind it.

Made of tough chrome-nickel-iron, individually cast under pressure. Unlike pressed-in seats, P-B Screw-In Valve Seats retain their original dimensions, won't buckle and come loose, can't tilt and cause hot spots and valve burning, and allow for perfect seating of valve on every stroke.



ONLY THE P-B SCREW-IN VALVE SEAT

P-B drill press unit for production installation. Also available HEAVY DUTY PORTABLE unit for jobs in or out of chassis—up to Diesel locomotives.

Takes the GUESSWORK Out of Valve Seat Replacement!

1. An exact *predetermined* expansion clearance is machined in between the threads of the P-B Screw-In valve seat.
2. P-B's precision tooling makes the only precision counterbore in the replacement field. Non-adjustable end-mill cutters allow no variation in predetermined clearances.
3. Over 75% of the major fleets and bus lines in Canada have used this seat for over 12 years.

Special 8 and 12 fluted CUTTER and TAP makes only precision counterbore in replacement field and machines in expansion clearance between threads.

AMAZING PERFORMANCE

SAVES COSTLY BREAKDOWNS—Eliminates 75% of valve burning, sticking and breakage. Also eliminates 75% of valve port cracks due to radial pressure of expanding pressed-in seats—or valve port cracks in many heads where no seats are used.

REPLACEMENT OF SEATS MANY TIMES—WITHOUT OVERSIZE—You can replace P-B seats without damaging the threads in counterbore or going to an oversize.

NEW-ENGINE VALVE MILEAGE—And the seat remains tight in the counterbore.

EASY TO REGRIND—After long service just a light touch with the grinding stone cleans it up because it is not out of round.

SCREW-IN SEAT WITH EXPANSION CLEARANCE

CONTACT YOUR MASTER SHOP TODAY!

P-B Master Shops are now located in every major city in the U. S., ready to help you solve your toughest valve maintenance problems. Or write for further information:

PETERSON WELDING LABS, INC.

Dept. DP-9, 1423 Virginia, Kansas City, Missouri

New Roller Chain Book

A 148-page roller chain engineering data book, No. 2457, has just been published by the Link-Belt Company, 307 N. Michigan Ave., Chicago 1, Ill., and is available for distribution.

Detailed engineering information covers the selection, installation, lubrication, and maintenance of roller chain for drives and conveyors and sprocket wheels. For reference, the book contains a large number of photographs and drawings of the products in the company's precision steel roller chain line. Over 50 typical conveyor chain attachments are also shown.

Formulas, charts, diagrams and typical problems simplify selection. To facilitate selection of drives for normal requirements, one 24-page section contains a group of pre-selected drives which are available for delivery from stock.

The book offers a guide to the application of stainless steel and bronze chains. Included is a table which lists the degree of resistance of these metals to 400 corrosive re-agents.

Case Hardening Steel

Standard batch furnaces for case hardening steel are the subject of a bulletin just released by Surface Combustion Corporation, Toledo 1, Ohio.

Controlled atmosphere equipment, including muffle furnaces and generators, plus salt bath pot furnaces and direct-fired oven furnaces, are shown and described with typical applications to gas carburizing, liquid carburizing, and cyaniding and pack carburizing.

Railroad Equipment Booklet

Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa., is offering a 12-page booklet, "Railroad Equipment for Today and Tomorrow". The booklet opens with a brief discussion of propulsion motors and control, and then concentrates on the broad line of auxiliary equipment manufactured for the railroad industry.

Illustrative sections are included on power generation and distribution equipment, and electrical equipment for yards, shops and stations.

IF YOU'RE A DIESEL EXECUTIVE

IN THE RAILROAD, UTILITIES, CONSTRUCTION, TRUCKING, BUS, SERVICE, OR ALLIED FIELDS

then you'll be interested in the special offer DIESEL POWER AND DIESEL TRANSPORTATION is making that will help your personnel to operate at peak efficiency.

Other top diesel men have alrady found that DIESEL POWER AND DIESEL TRANSPORTATION . . .

. . . spells out basic diesel facts to their employees — especially helpful in training men new to the ways of diesels.

. . . supplies practical tips that help their subordinates slash maintenance and operating costs.

. . . brings their top personnel the latest news on new engines, parts, and services.

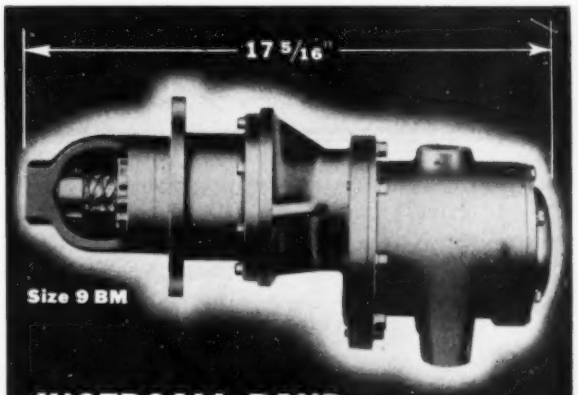
They've enterd scores of group subscriptions for their employees because they've found it's "good business" to have this channel of diesel information at the fingertips of their key men.

You can give your employees that same aid to more efficient performance — and for as little as 50% of our regular subscription price.

Our standard one year subscription price is $3.00. However, if you enter 5 through 9 subscriptions, your rate will be but $2.00. Moreover, on 10 or more subscriptions, you need pay only "half-price" — $1.50 — per subscription.

Merely send us the list of names for whom you wish subscriptions entered. We'll then send you the necessary invoice, and start the issues rolling. Please address your orders to:

DIESEL POWER AND DIESEL TRANSPORTATION
192 Lexington Avenue
New York 16, N. Y.



INGERSOLL-RAND AIR STARTING MOTORS

FOR A SURE ENGINE START *Every Time*

- **No Batteries or Generator Necessary**
- **Reliable Starting Under All Conditions**
- **Easy to Install**
- **Compact—Powerful—Light Weight**
- **Practically No Maintenance Expense**
- **Proven Multi-Vane Air Motor**

An Air Starting Motor is small and compact. It eliminates the need for banks of storage batteries, generators, voltage regulators and electrical devices. It will pay for itself in one year through savings on battery replacement alone!

Ask your engine distributor to show you the Ingersoll-Rand Air Starting Motors designed for your engines . . . or write for Form 5094, which contains Air Starting Motor selections for all popular engine sizes up to 3000 cubic inch displacement.

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

822-B

Field Notes

Heavy Hauling With Torque Converters

Torque converter-equipped mining trucks take most up-grades without shifting and down-grades without the use of brakes.

Friction and fluid drives used throughout the mining industry to put machines to work more efficiently, will be displayed at the annual Mining Show of the American Mining Congress in Denver, September 22 to 25, by the Twin Disc Clutch Company, Racine, Wisconsin.

The display will include the truck type hydraulic torque converters, whose exclusive braking features and high torque multiplication are setting new standards for operator ease, trip time and low maintenance in open pit mining.

A motor driven clear plastic model of the converter will demonstrate how the three-stage design builds up high torque output (up to 6-to-1), and how the valve-actuated or automatic-acting braking features function to combine with engine compression and friction to perform up to 90 per cent of braking in mine hauling.

Commercial Filters Corp. Moves

The Commercial Filters Corporation has moved into its new factory and office building located in Melrose, Massachusetts on the north side of the Boston metropolitan area.

Welding Classes for Fall

A regular schedule of weekly classes in advanced welding techniques, starting with the week of September 15, with a new session commencing every two weeks thereafter, has been released for the Eutectic Welding Institute by Eutectic Welding Alloys Corporation.

Detailed course outlines, schedules, and additional information may be obtained by writing to this corporation, 172nd Street at Northern Blvd., Flushing 58, New York.

Operating Engineer Handles Two Bolted Caterpillar D'8s

One portable engineer can operate two conventional Caterpillar D-8 tractors that have been bolted together to make one gigantic machine with a drawbar hp of at least 270. The unit was assembled by engineers of Peterson Tractor and Equipment Company of California.

In assembling the Siamese D-8 tractor, one track and final drive assembly was removed from each unit. A special hard bar was used to bolt the machines together at the final drive housings, by aid of a large through bolt. At all times, one operator is in control of both tractor engines. He operates from the driving position of the right tractor.

Controls for both machines are operated separately, with the exception of the master clutch controlled on both rigs by one lever. By reversing one side, the machine can be swung around in its own tracks, allowing use of the dozer blade on the return trip through the cut.

The machine supports a dozer blade 16 ft wide and five ft high and can fill a 30-cu yd scraper without pusher assistance, under conditions where two conventional tractors are customarily used.

Historical Grad Exercise Duplicates 100 Years Ago

America's oldest technical college, Rensselaer Polytechnic Institute, at Troy, New York, rolled back history a hundred years last month when it awarded civil engineer degrees to four of the nation's outstanding engineering leaders.

The recipients were Charles F. Kettering, director and research consultant of General Motors Corporation; Carlton S. Proctor, of New York, president of the American Society of Civil Engineers; E. D. Blackwell, 100 years old, of Goshen, Vermont, who graduated from Rensselaer in 1874 and

who now is the school's oldest living alumnus; and Major Lenox R. Lohr, president of the Museum of Science and Industry in Chicago.

Staged as one of the features of the Centennial of Engineering program, the ceremony was almost an exact reproduction of the institute's graduation exercise a century ago when the first degrees in civil engineering ever given in any English-speaking country were awarded to four of its graduates.

According to President Houston, the new degrees awarded to these engineers last month are bona fide civil engineering honors and have the same status as the regular degrees awarded to graduating students up to the 1930s when a degree of Bachelor of Science in Civil Engineering was substituted for the straight degrees.

Waste Material Contributes To Underground Security

Waste material from ore has been put to use to increase underground security at the mines of the International Nickel Company of Canada, Limited. Sand recovered from mill tailing, the waste in the ore concentrating process, is mixed with water and flushed through pipelines back into the ground. There it serves as fill for mined-out stopes or to stabilize areas previously filled with rock.

The sand-filling system is a development in the company's $150,000,000 long-range program of conversion from open-pit and underground mining to all-underground production at its five mines in the Sudbury District of Ontario. For 20 years waste rock has been used, but it was recently found that sand constitutes a more suitable fill, permitting faster and more efficient underground operations. Now it is piped into the mine at the rate of more than 3000 tons a day.

The water-borne sand filters and packs into the rock-filled areas and solidifies them so that they are not only self-supporting but also strong enough to sustain the increased weight as remaining pillars of ore are removed during the secondary stage of mining. More than 3,500,000 tons of sand fill will be required to stabilize all the rock-filled areas.

Electrochemistry Fellowship

A graduate fellowship in electrochemistry, believed to be the first limited to basic research in this field, was announced by the University of Michigan.

Established by General Motors to train electrochemists for key industrial positions, the fellowship provides a cash award of $1800 to the fellowship and $1000 to the University to cover tuition, special apparatus and other incidental costs. It will be offered during 1952-53 and will be subject to renewal from year to year.

New Dock and Warehouse For Weirton Steel

The Weirton Steel Company will construct new harbor facilities and a warehouse at its Weirton West Virginia plant. Dravo Corporation of Pittsburgh has been awarded the construction contract.

HERE IS ONE MAN WHO CAN HELP KEEP CRANKSHAFT RECONDITIONING COSTS DOWN

The initial cost of a diesel crankshaft grinder is the one single item that contributes more to grinding cost than any other factor.

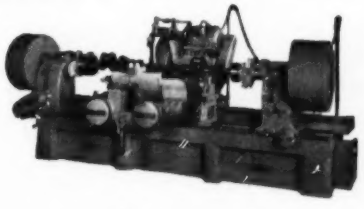
By being the first to redesign cumbersome costly grinders Lempco expanded the opportunities and lowered the cost of shaft grinding.

Shafts from Alco, Cummins, Fairbanks-Morse, EMD, Cooper-Bessemer, Superior, Waukesha and others are ground with the simplicity, accuracy and speed that has made the name Lempco associated with the best crankshaft regrinding equipment in the industry.

Lempco grinders feature advances that can be found nowhere else.

Among the features are an outboard balancing system that balances any shaft in a matter of seconds; rapid hydraulic infeed and retraction; variable hydraulic traverse feed for power grinding; pressure-ized "oil-cushioned" wheel spindle for accurate fillet grinding, and the all important 360° graduated throwhead that eliminates rechucking the shaft for each new set of crank throws.

There is one way to keep abreast of growing diesel rebuilding service. Have one of our fie!d service men go over your requirements and make a recommendation of the type of machine best suited for your shop. The information is yours for the asking. Write to A. B. Harding, Vice President Sales, Lempco Products, Inc, Bedford, Ohio.



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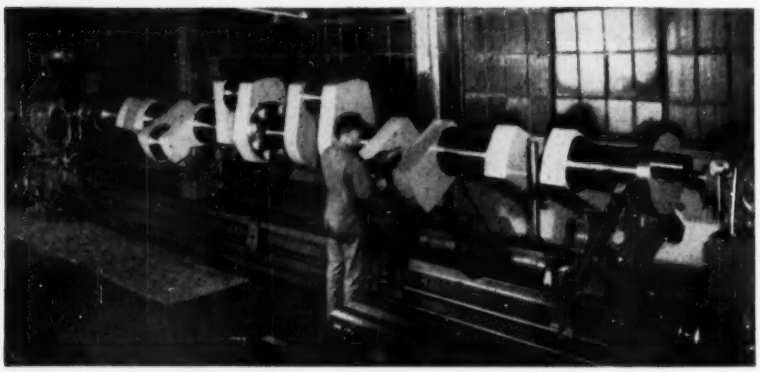
For 35 Years — a leading builder of machine tools

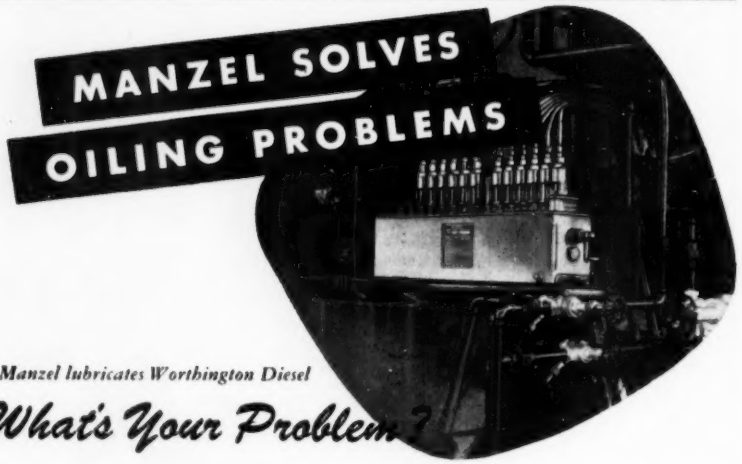
DIESEL CRANKSHAFT REPAIRING AND REFINISHING



Picture shows a thirty-foot crankshaft with 13" diameter journals which was broken through the No. 6 web— receiving final inspection after new crank and center coupling sections were installed and machined to original tolerances.
Shafts of all sizes and types successfully repaired and refinished.
Call, wire or write for particulars on our field repairs and emergency service.

WASHINGTON IRON WORKS, INC.

Established 1876
SHERMAN, TEXAS



Manzel lubricates Worthington Diesel

What's Your Problem?

Insure many years of economical, trouble-free service from all types of machinery with *Manzel* Force Feed Lubrication. Adaptable to numerous difficult oiling problems, "Manzel's" can be engineered to *your* requirements. Experienced representatives throughout the country.

Just Write

Manzel

271 BABCOCK ST.
BUFFALO 10, N. Y.

Perfection Stove Builds 90-Below Test Laboratory

Temperatures as low as 85 degrees below zero are currently being reached in a sub-zero laboratory recently built by Perfection Stove Company in Cleveland.

Capable of a temperature of –90°F, the laboratory, built at a cost of $250,000, was developed to test the starting characteristics of fuels and lubricants, the metallurgy of metals, the characteristics of materials, and the efficiency of heating devices at temperatures ranging from –65°F to –85°F.

The building is a 60 by 60 ft structure with the sub-zero laboratory and ante chamber inside. Walls are insulated with a 12-in thickness of rock cork, the exterior wall and ceiling flooded with asphalt. The ceiling is applied on top of transite-corrugated board supported by wood beams.

The laboratory, large enough to house two buses, is refrigerated by three Brunner compressors hooked up in a 2-stage system, with liquid F-22, as the refrigerant. One Brown recording temperature controller controls the system and is capable of maintaining the laboratory at the setting of plus or minus 2°F.

A Pittsburgh Lectrodryer supplies makeup air to the room at minus 10° dew point during a live load test at –65°F, and dries the room prior to a pull down. This latter reduces the rate of frost build-up on coils. Six Thermopane viewing windows permit a check on cold chamber activities from the ante-chamber.

The sub-zero laboratory can produce cold which will change oils and diesel fuels to solids, cause metal to brittle, and cause gasoline to extiguish a fire, under test conditions at –65°F.

200-Ton GE Stator Makes Difficult Trip

Two years of transportation planning were climaxed recently with delivery of a giant GE 401,000-lb stator for one of the world's largest generators in Consolidated Edison's power plant at the East River in New York City.

(*Continued on page 76*)

Star Performers For High Pressure

500 Series
Rotary Geared Pumps
with Herringbone Gears

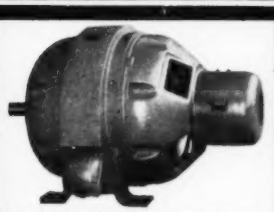
These quality-built Brown & Sharpe pumps are particularly suited for diesel pressure lubricating systems up to 500 p.s.i. Needle bearing construction, combined with balanced herringbone gear design, assures smooth, dependable operation at high speeds. Leakage problems eliminated by use of double self-balancing mechanical seal . . . no glands to adjust. Six sizes available with capacities from 5.1 to 37.6 g.p.m. at 0 lbs pressure. Operating characteristics fully described in Pump Catalog. Write for copy. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

WE URGE BUYING THROUGH THE DISTRIBUTOR

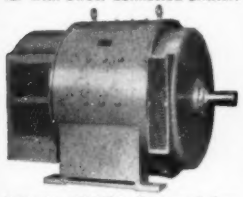
BROWN & SHARPE IBS

Champion Performers

COLUMBIA



93.8 KVA, 900 RPM, A. C. Generator with Direct Connected Exciter.



200 KW, 900 RPM, Protected, Two Bearing D.C. Generator.

A. C. AND D. C. GENERATORS. For the greatest exhibition of quality and service use performance proved Columbia A.C. and D.C. Generators. Available for coupled service, belt drive, single or two bearing.

A. C. Generators: 6¼ to 1000 KVA
D. C. Generators and Exciters: 2 to 300 KW

Write for descriptive literature. Our engineers will be glad to review your requirements.
Protected Territories Available to Qualified Sales Engineers.

COLUMBIA ELECTRIC MFG. CO.
4537 HAMILTON AVE · CLEVELAND 14, OHIO

These Fram Filcron Filters clean about 100 gallons of oil an hour at temperatures of 150-160 degrees for INVADER'S 180 hp Superior Diesel Engine.

"I rate FRAM 100% for any diesel owner!"

says fishing boat engineer

Fram Filcron Filter installation guards diesel engine of fisherman *Invader* of New Bedford, Mass., from costly and dangerous power stoppage due to oil contaminants . . . wins praise of boat's engineer, Arnold W. Bower. Without dependable diesel operation, fishing trips are unprofitable . . . and in bad weather uninterrupted power is vital to boat's safety.
Fram Filters contribute to *Invader's* profits by reducing down-time . . . keeping the *Invader* at sea for maximum lengths of time under all conditions. And the cost of Fram protection is small. Mr. Bower states, "replacing one essential bearing would be more than a year's filtering cost. I rate Fram 100% for ANY diesel owner."

Solve Your Filtering Problems with FRAM!

Whatever your filtering problem—lube or fuel—Fram Filters are the solution. Let Fram's Engineering Department PROVE that Fram Filters remove ALL engine-killing contaminants one micron (.000039") and larger . . . resulting in less down-time, lower operating costs for you. Make your diesels produce at lowest possible cost . . . write TODAY to the Fram Corporation, Providence 16, R. I. *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

FRAM *Filcron*

THE MODERN OIL FILTER

(*Continued from page 74*)

Taxing transportation facilities, the stators moved by rail, water and heavily reinforced trailer to the power house from the GE Schenectady plant. Two railroads, a specially-built flat car, a large marine derrick, a special barge, three tugboats, and a Manhattan firm of heavy hauling specialists were called upon to move the 30-foot component of a 175,000-kw generator.

The Erie Railroad's tunnels constituted the only system that could accommodate the stator, largely because the founder of the line insisted, 100 years ago, on a six-ft gauge for his tracks (later converted to the standard four-ft, eight and one-half-in gauge) and cut his tunnels to fit.

However, the engineer had to bypass the Otisville, N. Y. tunnel, travel only in daylight, when adjacent tracks were clear, and stay under thirty mph. The train had an empty car between the locomotive and the special flat car, to avoid straining bridges and trestles with their combined weight.

A special route was arranged through the city. So small were the clearances on some turns, that lines were painted on the street for guidance of those handling the job.

CHROMATE

FOR CORROSION CONTROL

TYPICAL APPLICATIONS . . . . . .

LOCOMOTIVE DIESELS—Add 6 lbs. of Sodium Chromate to systems having a capacity of about 250 gal., and maintain concentration at about 2,500 ppm.

MARINE DIESELS—Start with about 2,000 ppm. of Sodium Chromate in the engine-jacket system, and maintain this concentration. Submarines and some other naval vessels provide an additional factor of safety by employing 5,000 ppm.

STATIONARY DIESELS—Start large installations with closed engine-jacket systems by adding 1,000 ppm. of Sodium Chromate; later maintain about 400 ppm. For smaller installations, employ higher concentrations. For open systems, start with 500 to 1,000 ppm. of Sodium Chromate and lower the concentration over a period of 1 to 3 months to the lowest maintained concentration at which protection is satisfactory, usually about 200 to 500 ppm. For large open systems employing cooling towers, use Sodium Bichromate and adjust to pH 7-9.

Write for complete information about the application in which you are interested.

SODIUM BICHROMATE • SODIUM CHROMATE • POTASSIUM BICHROMATE • CHROMIC ACID

MUTUAL CHEMICAL COMPANY OF AMERICA

270 Madison Avenue New York 16, N. Y.

SINCE 1845

Mutual Chromium Chemicals

Marine Diesels Going Strong After 26 Years In Service

The former tugboat Shaver, now named the Western by her new owner, the Western Transportation Co., is still operating reliably 26 years after conversion to diesel power.

Originally a steam powered stern wheeler, conversion to a twin-screw diesel-powered boat was made in 1926 with the installation of two 400-hp, 6-cyl Atlas Imperial direct reversible marine diesel engines. J. H. Johnston, naval architect was given the assignment of drawing up the conversion plans, which included the twin screws and a tunnel stern, with two main rudders aft and a pair of monkey rudders forward of the propellers, all controlled by Johnson-Fries pneumatic steering gear.

After three years of service, totalling 17,500 working hours, the boat was laid up for a thorough routine inspection. The valves were ground, new rings installed and a 0.005 shim removed from each bearing. After another three years, total operating time of 35,000 hours, the company analyzed its costs and found they averaged a sum of 74.6 cents per hp per year.

In the next fourteen years of service, the engines received a new set of cylinder liners and crankshaft bearings, and survived a fire that almost destroyed the vessel. In 1947, she was leased to the present owner, and purchased by it in 1949. Both engines were completely overhauled in 1950 at a cost of $6500 each, because the company feels the engines are good for another 10 or 15 years of life in a new hull.

Hagan Corporation, New Owner Of American Cast Products

Hagan Corporation, combustion and chemical engineering firm, has purchased American Cast Products, Inc., Orrville, Ohio. Hagan is one of many old customers of this grey iron foundry.

What Do You Know!

(Answers to questions on page 55.)

1. Correct answer is "c". Rotative speed alone does not take into account the length of stroke which is also a factor. For an example of this, see the article on Page 32.

2. "a" is correct. Discussion of this also appears in the article referred to above. Note, for example, the low installation costs.

3. Correct answer is "b". In addition to aiding starting, preheating has a pronounced effect on wear rates, maintenance, etc. See the article starting on Page 54.

4. Correct answer is "c". Neither "a" nor "b" alone will affect engine operation since the actual load is the product of volts times the amperes. See article on Page 56.

5. Both "a" and "b" are correct. For further discussion see the article referred to directly above.

6. All three are correct. Control of generator field excitation directly controls voltage and by doing so, can be used to limit current. Similarly, excitation control of traction motor fields during dynamic braking will regulate output and hence braking effect. For details see article mentioned above.

7. Correct answer is "c". Progressively bad pitting will be noticed on the bearing surfaces. See article on Page 48 for a complete discussion of the shaft current phenomena.

8. Both "c" and "d" are correct. The result is the same; the electrical path is opened. This is also discussed in the article mentioned above.

9. Correct answer is "a". Use of the lighter metals for crankcases and blocks, large housings, etc., cuts considerable weight. Harnischfeger is currently proving this, and now see the weights on the Packard engine in terms of horsepower in the article on Page 36.

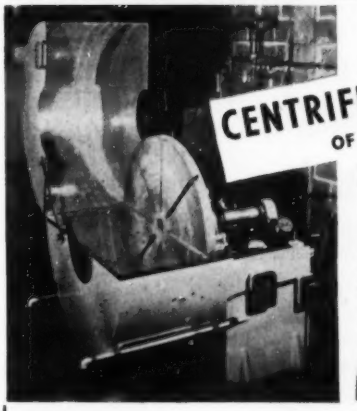
Consult ELLWOOD on all Your Forging Requirements

Quality Precision Crankshafts For Diesels — Since 1910 . . .

ELLWOOD CITY FORGE COMPANY

CRANKSHAFTS · CONNECTING RODS
MACHINE FORGINGS

ELLWOOD CITY, PENNA.



CENTRIFUGAL REBABBITTING
OF ALL SIZES OF BEARINGS

by DIESEL SPECIALISTS

From light weight high speed diesels to large low speed direct drive diesels. Specialized GOLTEN apparatus* makes it possible to return your bearings to service in a fraction of the time usually required in better-than-new condition because of the many improvements incorporated in the job.

REPAIR AND SERVICE on Woodward Governors and all types of fuel injection equipment and centrifuges.

FULLY EQUIPPED SHOPS for repairs and manufacture of parts, for pipe bending and coppersmith work; large stock of spare parts on hand.

*Patents pending

DAY & NITE SERVICE ULster 5-7200

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455 CARROLL ST., B'KLYN 15, N. Y.

Affiliated Companies
HYDRAULIC HOIST CORP., Renton, Washington
ATLANTIC DIESEL A/S, Oslo, Norway
NORLANTIC DIESEL, INC., New Bedford, Mass.

SAE West Coast Meeting

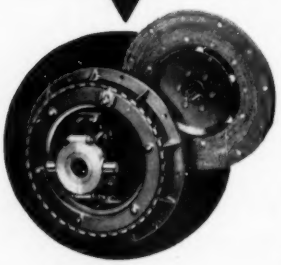
Review of truck maintenance practices and evaluation of new-type power plants, were undertaken at the SAE National West Coast Meeting at San Francisco, Calif. Technical men of the automotive, petroleum, and other industries assembled by the Society of Automotive Engineers specifically considered the new Humphreys controlled-compression engine, the gas turbine, and supercharged diesels.

Locomotive Maintenance Assoc. Holds Annual Meeting

The 1952 annual meeting of the Locomotive Maintenance Officers' Association takes place in Chicago this September. The subject up for discussion is diesel locomotive maintenance problems.

Topics for discussion are: Apprentice Training; Oil Leaks, Crankshaft & Bearing Failures; Possibilities of Diesel Parts Reclamation; Standardization, Control and Distribution of Tools for Diesel Work; Diesel Locomotive Cleaning; Determination of Diesel Facilities; Wheel Slip Detection; and Flashovers, Cause and Prevention.

Tractors and Pipe Lines



Go Right Thru Obstacles

ALLIS-CHALMERS tractors are rugged enough to absorb the punishment met in transcontinental pipe-line construction. Heavy-duty ROCKFORD CLUTCHES help them move maximum size loads thru tough going—with ample margin of safety. Let ROCKFORD clutch engineers help you design dependable, flexible controls for *your* machine's powerline.

ROCKFORD CLUTCH DIVISION BORG-WARNER
1301 Eighteenth Avenue, Rockford, Illinois, U. S. A.

B-W
B-W ENGINEERING MAKES IT WORK
B-W PRODUCTION MAKES IT AVAILABLE

ENGINEERING BULLETIN SENT ON REQUEST

ROCKFORD CLUTCHES

First Waterwheel Generator Built in West

The first waterwheel generator built west of the Rockies will be installed in the hydroelectric generating station on the Willamette River in Oregon City, Oregon, one of the nation's oldest electric power plants.

In operation since 1893, the plant is now being rebuilt. This plant superseded the original Oregon City power plant that in 1889 generated power that was transmitted 14 miles from Oregon City to Portland, an event recorded as the first long distance commercial transmission of electric power in the nation.

"Living" Cornerstone For Chicago Museum

A "living" cornerstone was placed at Chicago's Museum of Science and Industry this month, at the opening day of the two-week convocation of the Centennial of Engineering. Although the building dates back to 1893, the cornerstone was never laid.

Everything in the cornerstone is physically or biologically "alive". Some of the stone's contents are radioactive. A specially constructed clock will count off years inside the cornerstone.

A carefully fabricated monel metal box, surrounded by helium, was placed into the heart of the one-ton block containing a number of laboratory experiments designed to prove or disprove today's theories in an experiment that will last 100 years.

Small amounts of dry hydrogen and oxygen in the proper proportion to form water is among the contents, which should react very slowly due to the absence of any catalyst. Some believe no reaction will take place in the hundred years, while others believe it will violently occur.

In another sealed capsule are Oriental lotus seeds, traditionally associated with longevity. When that is opened,

scientists will have more accurate data to predicate the ability of seed to maintain germination qualities. Several kinds of biological molds, viruses, and bacteria will also have a hundred year test to determine their longevity.

In a metallurgical experiment, a sample of an age-hardening metal alloy is included. This alloy, after 100 years, should show increased properties of hardness and strength.

A thermostatic clock to count the years will operate with temperature changes. The thermostat is set to register once Chicago's temperature passes 85° and then will not register again until the temperature has gone below 15°. In this way, summer and winter weather, despite wide fluctuations, will operate the clock.

Continuous Steel Rail For Rock Island

The Rock Island Lines is commencing its first installation of continuous type steel rail as part of its quest to reduce mounting maintenance costs and provide a more comfortable ride for its patrons.

Laying of the first five-mile strip of rail has been started just west of Peru, Illinois on an experimental basis. The rail is in 1500-ft lengths which require 40 flat cars for transport to the site. The lengths are welded together when set down. Eliminated will be the familiar click, click, which for a century has lolled passengers to sleep.

Proto Tools Factory Built in Canada

Construction work has begun on a new Proto factory in London, Ontario, it was announced by the president of Plomb Tool Company, manufacturers of Proto tools. This plant, the company's fifth, will provide modern facilities for the manufacture and distribution of Proto tools in Canada.

A new corporation, known as Proto Tools of Canada, Ltd., was formed earlier this year, and a 50-acre site was acquired in a new industrial section of London. Initially, the plant will have a floor space of 21,000 sq ft and as the factory is expanded and more personnel added, the plant will become a prime manufacturer of tools.

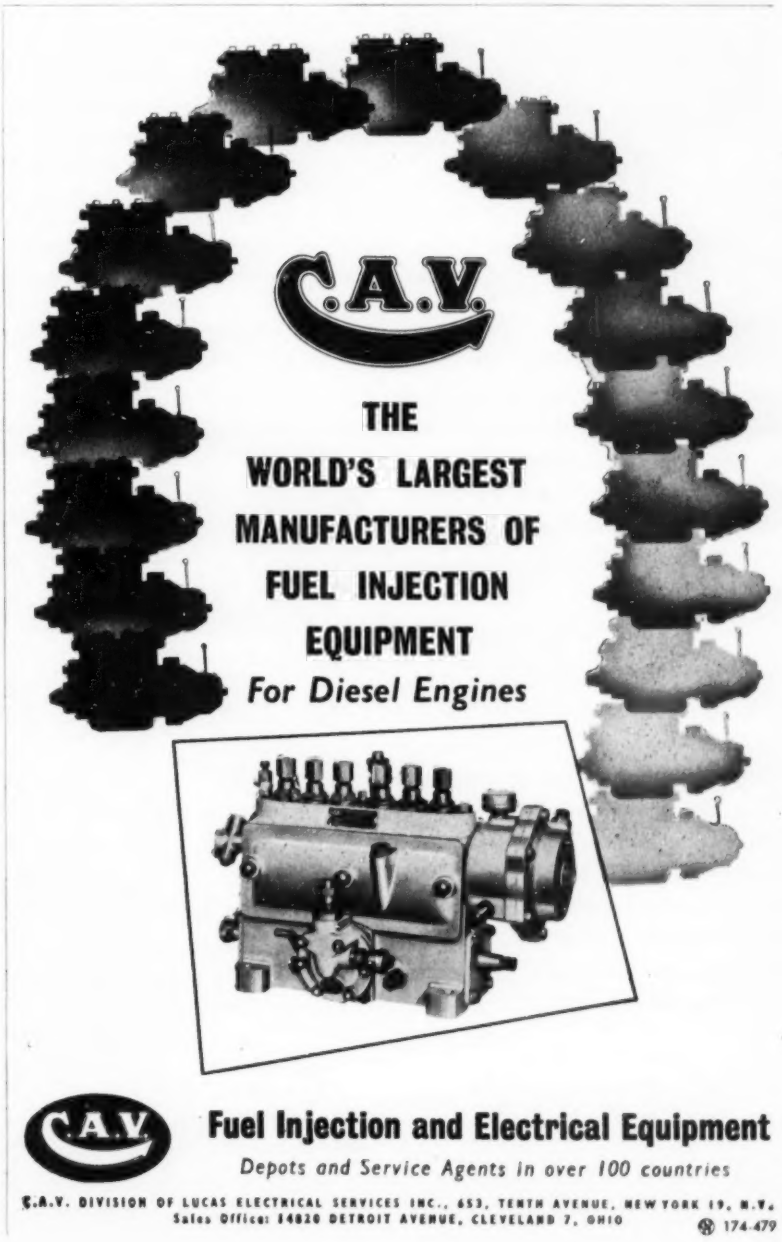
Penn RR Claims Largest Train Communication System

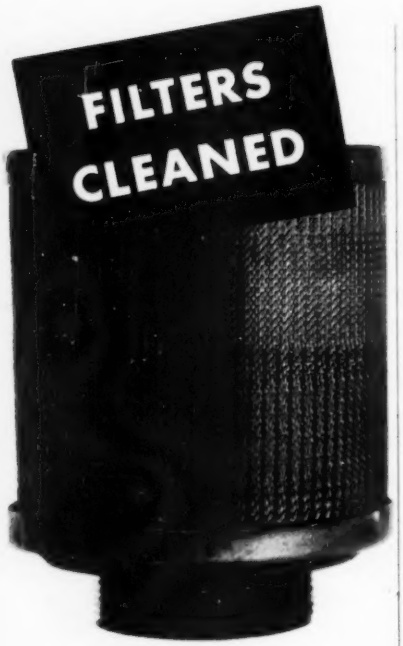
With nearly 1300 trainphone units in service on trains and in wayside control towers along about 2,000 miles of line, the Pennsylvania Railroad claims it is now operating the largest train communication system in the world.

The railroad has two-way telephone equipment on 916 locomotives, 230 freight train cabin cars, and in 122 wayside control towers. There are also 25 walkie-talkie portable units in use. Nine million dollars have already been invested in the system and plans are being made to expand the network over the entire road.

Bohn Aluminum Contracts

All export activities of the automotive replacement products division of the Bohn Aluminum and Brass Corp. of Detroit, are to be handled by Borg-Warner International Corp. Bohn is a manufacturer of bearings, connecting rods and other automotive components.





easier, faster at lower cost

Whether your particular job is the cleaning of doughnut type air filters, or desludging Michiana lube oil filters or cleaning sintered bronze fuel oil filters—you can be sure that specialized Oakite cleaning materials and methods will do a good job, a fast job *and* save you real money.

Consult Oakite on all Diesel Maintenance Cleaning

Why not discuss your filter cleaning problems with the Oakite Technical Service Representative nearest you? He'll gladly show you blue prints of job-tested Oakite filter-cleaning set-ups. There's sure to be one to take care of your requirements successfully. See him today or write for free data to Oakite Products, Inc., 22C Rector Street, New York 6, New York.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
Technical Service Representatives Located in Principal Cities of United States and Canada

Diesel Scores Over Electric Power In Irrigation Project

Washington farmers are now diesel minded when it comes to powering their sprinkler irrigation systems. During the past two years, a large number of electric pumping units have been replaced by diesel.

Comparison of operating costs of a diesel powered sprinkler system and a motor driven set working in adjacent fields of pasture land has been made. Over a five month season, the electric driven pump cost $7.90 per acre on a 20-acre plot; the diesel set, cost $2.51 per acre for a 38-acre field: over two-thirds saving.

Taking into consideration the cost of running a power line to the electric pump, there is no appreciable difference in initial investment and installation costs. A portable diesel pumping unit, however, requires considerably less aluminum irrigation piping than a centrally located permanent electric pump. With the diesel, too, no transformer rent has to be paid during the idle seven months of the year.

The average size irrigation system being used in Washington requires some 250 gal per min at a 120 ft head. The water is generally lifted from slough at the end of the field, or in some cases the water is pumped from a well.

The diesel engine used for this operation is a Petter two-cyl model AV2, which develops 10 hp at 1500 rpm. Both air and water cooled versions are used. The pump is a Myers centrifugal type driven by "V" belting. The whole set, including the fuel tank, is mounted on a common skid, conveniently transportable by tractor. Easily started by hand, the engine when operating at full load, consumes only 0.4 gal of fuel per hr.

King Engineering Assigns Rep

King Engineering Corporation, Ann Arbor Michigan, announces the appointment of the Applied Engineering Company as representative serving North Carolina, South Carolina, Georgia, Alabama and eastern Tennessee.

TITUSVILLE *Diesel* CRANKSHAFTS

Precision Tolerances and Finishes as your Requirements demand . . . Turn to Titusville for Engineering and Research Counsel—an organization of master Craftsmen with facilities second to none in the industry.

Struthers Wells
STRUTHERS WELLS CORP. *Titusville Forge Division*
TITUSVILLE, PENNA.

Stewart-Warner Buys Uni-Gun

Stewart-Warner Corporation has purchased substantial stock interest in Uni-Gun Lubricating Equipment, Ltd., of London, England, which manufactures a limited line of products similar to its Alemite lubrication equipment line.

It is announced that Stewart-Warner intends to expand operations of the English company for the purpose of distribution of both companies' products in the world markets. Stewart-Warner will have operating control of the English firm.

New Plant for Carbide & Carbon

Design and engineering work are underway for a new plant in Los Angeles County for Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation.

The project will involve an eventual investment of more than $36,000,000. It is being designed to produce from 50 to 60 million lb of plastic polyethylene and from 5 to 10 million gal of ethylene glycol a year. It will be the first plant on the Pacific coast to produce these products.

New Nordberg Distributor

Mead Engine and Welding Works, Sterling, Kansas, has been appointed an industrial distributor for Nordberg 4FS diesel engines. This firm will cover all of Kansas except the northeast section.

Long Island Institute Opens New Machine Shop

Formal opening of a new $2,500,000 machine shop at the Long Island Agricultural and Technical Institute, Farmingdale, claimed to be the largest single building in the United States for technical and institute training, takes places this September. The institute is a unit of the State University of New York.

The two-year training courses in mechanical technology are given free to graduates of New York state high schools. The courses comprise automotive and diesel work, metal production manufacturing, refrigerating, heating and air conditioning, electrical equipment and instrumentation, radio communication, building construction, highway and bridge construction, and aircraft operation. There are 720 enrollments for courses this year, but the new shop will ultimately permit an increase to 1600.

New Branch Warehouse for Quaker Rubber Corp.

A new stock-carrying branch warehouse and sales office has been established by Quaker Rubber Corp., a division of H. K. Porter Co., Inc., in Minneapolis, to provide better service and deliveries in the Twin Cities industrial area.

Aeroquip Ups Dividend Rate

Reflecting record sales and earnings during the first nine months of the current fiscal year, the board of directors of Aeroquip Corporation voted to increase the regular quarterly dividend rate from 5 cents per common share to 7½ cents.

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Organizational News

New Post at Penn RR

Arthur F. McSweeney was recently promoted to the newly created position of assistant chief of freight transportation. The post carries the responsibility of improving freight service in yard and terminal operations and evolving more efficient and economical methods of transportation.

Arthur F. McSweeney

Until his promotion, Mr. McSweeney was acting chief of freight transportation. His entire 41-year railroad career has been spent in the company's service.

Division Manager Named

Shell Chemical Corporation has appointed J. M. Selden manager of its eastern division.

Mr. Selden has been associated with the marketing of the company's products since 1933, and he has been instrumental in the marketing of the company's line of solvents, industrial chemicals, and resins and plastics. In his new position he will administer sales activities and assume a chief part in the introduction of new products to Eastern markets.

Alco Names Director

George Y. Taylor has been promoted to director of personnel for the diesel locomotive and ordnance divisions of the American Locomotive Company.

He joined the company in 1946, and under his direction the Alco-GE diesel-electric locomotive school was organized. Taylor has been in charge of the supervisory development program for foremen and supervisors, a junior engineer's training program, and employee training courses. He also directed the publication of technical manuals.

He is a native of Lewisport, Ky. and received a master's degree in education at the University of Pittsburgh in 1937.

Scientists For Allis-Chalmers

Appointment of four new research scientists, all holders of doctorates, has been announced by the Allis-Chalmers Manufacturing Co. of Milwaukee, Wisc. The men are Fabian Bernstein, John W. Dzimianski, C. W. Little, Jr., and Ralph A. Person.

Bernstein obtained his doctorate in 1952 from the Polytechnic Institute of Brooklyn where he served as a teaching and research fellow. Both Dzimianski and Little received their doctorates from Johns Hopkins University. Person received his doctorate in 1952 from MIT, where he was a research assistant for three years.

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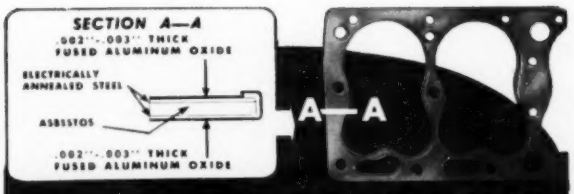

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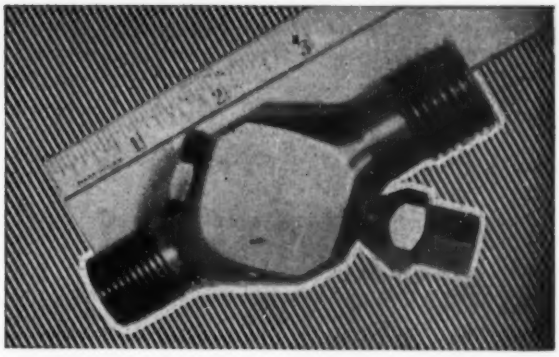

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Research Chief Retires

Paul Diserens, after 43 years of service as director of research and development for Worthington Corporation, is retiring from active service. He will continue in a technical consulting capacity.

Paul Diserens

Mr. Diserens joined the company in 1909, and was placed in charge of research testing at Cincinnati. Here he developed the Worthington feather-valve and variable capacity control for compressors. He progressed to chief consulting engineer and later became director of research. In 1944, he was appointed to the position he is now leaving.

Mr. Ralph M. Watson, who joined the company in 1936, assumes the post Diserens is vacating.

Fairbanks, Morse Promotes

Fairbanks, Morse & Co. announces the appointment of R. H. Morse III as general manager of the company's Beloit, Wisconsin works. This marks the fourth generation of the Morse family to come to the management staff.

R. H. Morse III

R. H. Morse III is the great-grandson of the founder of the company. He succeeds Orren S. Leslie, who has been named manager of manufacturing and transferred to Chicago. Morse is a graduate of Princeton, with a degree in mechanical engineering. He began his career with the company in 1946, starting as a listing and release writer and working his way up to his present position.

Helmut Thielsch

Eutectic Director

Mr. Helmut Thielsch, formerly of the Welding Research Council, has been appointed to the position of director of applied welding engineering at Eutectic Welding Alloys Corporation of Flushing, New York.

Mr. Thielsch spent the past three years in charge of preparation of

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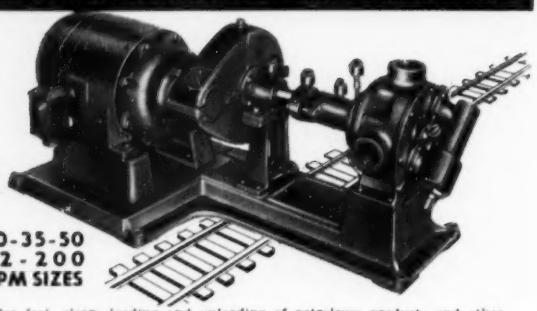

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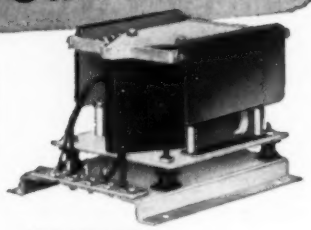

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critical correlated literature for research investigators and interpretive engineering reports for practical engineers. Some of the papers, he has been associated with are: "Hydrogen in Mild Steel Weld Metal", "Thermal Fatigue and Thermal Shock", and "Transition from Ductile-to-Brittle Behavior in Steel".

Anaconda Appoints Three

The Anaconda Wire & Cable Company, New York, announces three promotions: R. B. Steinmetz, vice president in charge of manufacturing operations; L. R. Love, vice president in charge of sales; D. E. Allen, general sales manager.

R. B. Steinmetz has been with the company since its inception, serving in various sales, engineering and manufacturing capacities. L. R. Love has been with the company and its predecessor companies for many years, as a sales executive. D. E. Allen joined the company in 1952, serving in sales and engineering capacities.

Changes for GM

General Motors research laboratories announces two staff promotions. John M. Campbell is the new assistant technical director on the general manager's staff, and succeeding him as head of the organic chemistry department, is Dr. Lloyd L. Withrow.

Mr. Campbell, a graduate of MIT, joined GM in 1926 as a member of the fuel section. In 1947, he was named to his previous position.

Dr. Withrow, a graduate of the University of Wisconsin, and a specialist in fuel and engine combustion studies, joined the company in 1926. He was promoted to assistant head of organic chemistry in 1948.

Borg-Warner Elections

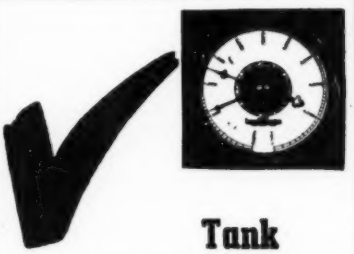
L. G. Porter and Ray P. Johnson have been elected vice presidents of Borg-Warner International, the export trade division of Borg-Warner Corp. Mr. Porter is also treasurer of the corporation, and Mr. Johnson, administrative assistant to the president.

Worthington Vice President Dies

Thomas Cruthers, Vice President of Worthington Corporation since 1936, passed away at his home in West Orange, N. J.

Mr. Cruthers joined Worthington in 1907, in charge of the gas engine field erection department. After successive positions of sales engineer, assistant sales manager, and sales manager in the New York office, he became assistant general sales manager and later assistant vice president in the general sales department.

Thomas Cruthers



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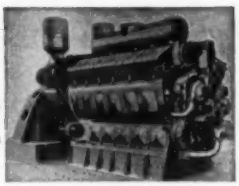

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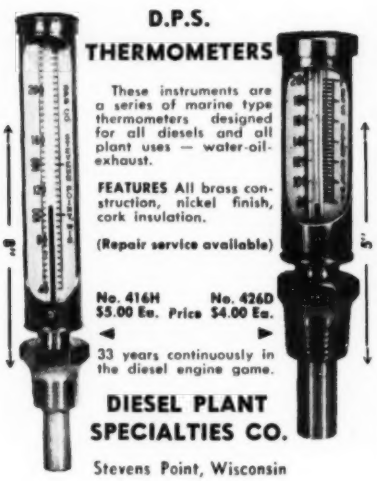

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ADVERTISERS' INDEX

Aerofin Corp. ... ***
Aeroquip Corp. ... ***
Air Maze Corp. ... ***
American Air Filter Co., Inc. ... ***
American Bosch Corp. ... 12-13
American Brass Co. ... 19
American Locomotive Co. ... ***
American Motors Co. ... 85
Ashland Oil & Refining Co. ... ***
Atlantic Metal Hose Co. ... ***
Automotive Products Inc. ... ***

Bacharach Industrial Instrument Co., Inc. ... 82
Baldwin-Lima-Hamilton Corp. ... ***
Bendix Aviation Corp. Scintilla Magneto Div. ... ***
Binks Mfg. Co. ... ***
Borg-Warner Corp., Rockford Clutch Div. ... 78
Boston Metals Co. ... ***
Bowser, Inc. (Petroleum Marketing Div.) ... ***
Briggs Filtration Co., The ... ***
Brodie System ... ***
Brown & Sharpe Mfg. Co. ... 75
Brush ABOE, Inc., Petter Engine Div. ... ***
Burgess-Manning Co. ... ***
Burlington Instrument Co. ... 84

C. A. V., Ltd. ... 79
Chicago Pneumatic Tool Co. ... ***
Cities Service Oil Co. ... 30
Cleveland Graphite Bronze Co. ... ***
Columbia Electric Mfg. Co. ... 75
Cook Mfg. Co., C. Lee ... 26
Cooper-Bessemer Corp. The ... ***
Cummins Engine Co. ... ***
Cuno Engineering Corp. ... 7

De Laval Separator Co. ... 4
Delco Products Div., General Motors Corp. ... ***
Delco-Remy Div., Gen. Motors Corp. ... 14
Detroit Diesel Engine Division, Gen. Motors ... ***
Diesel Injection—Sales & Service ... ***
Diesel Plant Specialties Co. ... 85
Donaldson Co., Inc. ... ***

Eaton Manufacturing Co. ... ***
Electric Auto-Lite Co., The ... ***
Electric Storage Battery Co., The ... 17
Electro-Motive Div., Gen. Motors Corp. ... ***
Electro Products Laboratories ... ***
Elliott Co. ... ***
Ellwood City Forge Co. ... 77
Enterprise Engine & Machinery Co. ... ***

Fairbanks-Morse & Co. ... ***
Federal-Mogul Corp. ... Third Cover
Fitzgerald Mfg. Co. ... 83
Flori Pipe Co., The ... ***
Fram Corp. ... 75
Fulton Slyphon Div., Robertshaw-Fulton Controls Co. ... 23

General Motors Corp., Delco Products Div. ... ***
General Motors Corp., Delco-Remy Div. ... 14
General Motors Corp., Detroit Diesel Engine Div. ... ***
General Motors Corp., Electro-Motive Div. ... ***
General Motors, Harrison Radiator Div. ... ***
Golten Machine Corp., Sigurd ... 77
Gulf Refining Co. ... ***

Harnischfeger Corp., P & H Diesel Div. ... ***
Harrison Radiator Div., Gen. Motors Corp. ... ***
Hercules Motors Corp. ... ***
Hill Diesel Engine Co. ... ***
Hilliard Corporation, The ... 81
Honan-Crane Corp. ... 68
Hunt-Spiller Corp. ... 25

Ideal Electric & Manufacturing Co., Inc. ... ***
Illinois Testing Laboratories, Inc. ... ***
Indianapolis Drop Forging Co. ... ***
Ingersoll-Rand Co. ... 71
Interstate Diesel Service, Inc. ... 85

Johnson Bronze Co. ... ***

Kelite Products, Inc. ... ***
Kent-Moore Organization, Inc. ... ***
Kiene Diesel Accessories, Inc. ... 83
Kittell Muffler & Engineering, Inc. ... ***
Koppers Co., Inc., American Hammered Piston Rings Dept. ... ***

Lanova Corporation ... ***
Leece-Neville ... ***
Lempco Products, Inc. ... 73
Lewis Co., Warner ... ***
Link-Belt Co. ... 28
Liquidometer Corp., The ... 85
Luria Engineering Corp. ... ***

Madison-Kipp Corporation ... ***
Manzel ... 74
Maxim Silencer Co., The ... 67
Merlin Engineering Co., Ltd. ... ***
Mid-Continent Petroleum Corp. ... ***
Missouri Portland Cement Co. ... ***
Mutual Chemical Co. of America ... 76

National Carbon Co. ... ***
National Welding & Grinding Co. ... ***
Nife, Inc. ... ***
Nordberg Mfg. Co. ... ***
Nugent & Co., Wm. W. ... 66

Oakite Products, Inc. ... 80
Ohio Crankshaft Co., The ... ***

Penn Controls, Inc. ... 63
Penn Flexible Metallic Tubing Co. ... ***
Peterson Welding Labs., Inc. ... 70
Petter Engine Div., Brush ABOE, Inc. ... ***
Phillips Petroleum Co. ... ***
Pickering Governor Co., The ... 9
Powers Regulator Co. ... 11
Pritchard & Co., J. F. ... ***
Pure Oil Co., The ... 15
Purolator Products, Inc. ... 10

Quincy Compressor Co. ... ***

Read Standard Corp. ... ***
Reiner & Co., John ... ***
Rochester Mfg. Co. ... ***
Rockford Clutch Div., Borg-Warner Corp. ... 78
Roper Corp., George D. ... ***

Schoonmaker, A. G., Inc. ... 85
Scintilla Magneto Div., Bendix Aviation Corp. ... ***
Sealed Power Corp. ... 6
Sharples Corp., The ... ***
Sims Co., The ... ***
Sinclair Refining Co. ... 21
Smith, E. R. ... ***
Snap-On Tools Corp. ... 65
Snow-Nabstedt Gear Corp. ... ***
Standard Oil Co., Inc. (California) ... 24
Standard Oil Co., Inc. (Indiana) ... Fourth Cover
Sterling Engine Co. ... ***
Struthers Wells Corp. ... 80
Surrette Storage Battery Co., Inc. ... ***
Synchro-Start Products ... 16

Texas Company, The ... 2nd Cover & 3
Thomas, C. H. ... 85
Thomas Flexible Coupling Co. ... ***
Tide Water Associated Oil Co. ... 8
Trane Co., The ... ***
Tuthill Pump Co. ... 82

U. S. Hoffman Machinery Corp. ... 64
Utilities Engineering Institute ... 85

Van Der Horst Corp. ... 18
Van Norman Co. ... 5
Viking Pump Co. ... 84
Vogt Machine Co., Henry ... 22

Washington Iron Works, Inc. ... 74
Waukesha Motor Co. ... 61
Weston Electrical Instrument Corp. ... 69
White-Roth Machine Corp. ... ***
Wildermuth, Inc., E. A. ... ***
Winslow Engineering Co. ... ***
Woodward Governor Co. ... ***
Worthington Corporation ... ***

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Pleased with performance of STANDARD HD oil are J. J. Tyler of Standard Oil (left) and Vail F. Shumaker, Superintendent of Center, Colorado, Municipal Power Plant, who worked closely together to solve a unique fuel-lubrication problem.

STANDARD OIL COMPANY

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